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Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Pedro Miguel Rodrigues Vicente Henriques

Project Work

presented as partial requirement for obtaining a Master's Degree in Information Management

NOVA Information Management School

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

IMPROVING THE MANAGEMENT AND EFFICIENCY OF A SPORTS CLUB MEDICAL CLINIC THROUGH BUSINESS INTELLIGENCE

By

Pedro Miguel Rodrigues Vicente Henriques

Project Work presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Business Intelligence.

Co-Advisors*:* Prof. Miguel de Castro Neto, Prof. Luís Batista and Prof. Vasco Jesus

May 2025

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Pedro Henriques

Lisbon, May 30, 2025

DEDICATION

To my wife, mother, father and especially my 5-year-old daughter, Margarida, for their high level of patience and understanding when she expressed interest in playing with her father several times and was unsuccessful. This work is dedicated to you for being the main pillar of all my personal, professional and academic achievements.

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ABSTRACT

This project work explores the application of Business Intelligence (BI) solution to improve the management and operational efficiency of a sports club's medical clinic. In the context of the professional sports sector, where the health of athletes and effective recovery from injuries are crucial to sporting performance, this study addresses the growing need for data-driven decision-making in clinical environments. Design Science Research methodology was used to develop a BI analytical relational model, using the Microsoft Fabric platform and the Power BI tool. The model was designed to process and analyse clinical data a sports organisation. The solution includes a relational data model based on a star schema and a set of interactive dashboards tailored to the main clinical, technical and management needs. These visual tools allow stakeholders to identify the most frequent injuries by sport, analyse average recovery times, monitor the volume of medical consultations and detect data classification problems. The study demonstrates how BI can support prevention strategies, assess and optimise resource allocation and streamline rehabilitation planning, through descriptive and prescriptive analyses. The results show a significant improvement in access to information and in the operational transparency of the clinic, as well as highlighting the potential for future research and expansion of the application of BI in sports medicine. This research contributes to filling the gap in the literature on BI in the clinical-sports context, offering a replicable model that combines technology with clinical management, promoting the well-being of athletes and organisational efficiency.

KEYWORDS

Business Intelligence; ETL; Microsoft Fabric; Dashboard; Sport Medical Clinic

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LIST OF ABBREVIATIONS AND ACRONYMS

AR	Augmented Reality
BI	Business Intelligence
DAX	Data Analysis Expressions
DSR	Design Science Research
DSS	Decision Support Systems
DW	Data Warehouse
EDW	Enterprise Data Warehouses
EIS	Executive Information Systems
EPTS	Electronic Performance and Tracking Systems
ETL	Extract, Transform and Loading
ICT	information and Communication Technologies
IDA	Integrative Data Analysis
IT	Information Technology
KPI	Key Performance Indicator
ML	Machine Learning
OLAP	Online Analytical Processing
SSBI	Self-Service Business Intelligence

1. INTRODUCTION

1.1. PROBLEM AND CONTEXT

We live in an era of constant technological evolution, where different sectors are gaining competitive advantages through innovative solutions. In the sports industry, the applicability of technology is becoming increasingly important in improving performance and success, as well as in the efficient management of the various sports infrastructures (Guerrero & Maciá-Andreu, 2024).

Business Intelligence is a set of useful tools and methods capable of strengthening the management and efficiency of sports medical clinics through the ability to explore large volumes of data (Almalki, 2017).

The concept of Business Intelligence emerged in the 1950s, when Hans Peter Luhn introduced the term in his article 'A Business Intelligence System'. Luhn (1958) proposed an automatic system for collecting, processing and disseminating information within organisations with the aim of improving communication and the decision-making process. Later, in the 1980s, BI evolved significantly due to progress in data management and processing (Botelho & Filho, 2014). There has been a constant and considerable development of technology in relation to the capacity of BI systems. Organisations can examine large amounts of data and integrate different processes and methodologies. It is currently a crucial tool for organisations seeking to guarantee competitive advantages in terms of the agility and precision of data analysis and strategic planning (Daniel, 2020).

1.2. OBJECTIVES

Health and well-being are determining factors for athletes' performance and success (Yang et al., 2024). Sports medical centres play an important role in monitoring athletes' needs (Drew et al., 2023). Through the application of BI, it is possible to monitor, prevent or predict the health of athletes and maximize their sporting performance (El-Maghrabi & Sharif, 2022). The use of dashboards enables the interactive visualization of real-time information on essential and important metrics for the planning and decision-making process of end users (Almalki, 2017). This makes it possible to obtain more accurate medical diagnoses, monitor the recovery time of certain injuries, and facilitate sports technical teams in the decision-making process (Tapia et al., 2020).

1.3. RESULTS AND CONTRIBUTIONS

Despite the benefits, there is, however, a significant gap in the research of scientific articles related to the applicability of BI in the management of sports medical clinics. This research aims to fill this gap by scrutinising how a BI model can positively impact the management and efficiency of a sports club medical clinic. This dissertation aims to develop a relational data model, as well as interactive dashboards with detailed information on diagnoses, pathologies and recovery times for athletes.

This thesis will follow the Design Science Research methodology, which will guide the process of creating, developing and evaluating the analytical model. Tools such as Power BI and Microsoft Fabric will be used to visualize and investigate medical data involving a wide range of information, such as diagnoses, consultations, pathologies, athlete profiles, recovery times, among others.

It is hoped that the results of the realization and development of the aforementioned artefact, as well as its analysis and evaluation, will make a significant contribution to improving the efficiency and management of a sports medical clinic, to improving the overall performance of athletes in terms of injury prevention, and to improving the decision-making process of end users (doctors, physiotherapists, physiologists, technical staff) in order to optimize treatment and recovery times for athletes.

It is hoped that this research will serve as a reference for future research and the development of new technological solutions in the sports industry, and that it will make a relevant contribution to the academic sphere in terms of enriching the literature on the applicability of BI in the specific sector mentioned above.

2. LITERATURE REVIEW

2.1. Technologies in a Sports Sector

Ratten (2020) assumes that technology has a significant impact on the sports industry by increasing international competitiveness and integrating scientific advances. Understanding the various contexts and phases of sport, which are constantly evolving, can lead to more efficient and effective technological innovations and strategies.

According to Omoregie (2016) the path of technology in the sports sector has taken on an innovative and growing role since its introduction in the timing system of races in the last decade of the 13th century to the incredible modern advances of today.

There are several technologies applied in the most diverse aspects of this sector whose results and purposes are so positive and significant for the evolution of the performance of the players in general (Liebermann et al., 2002).

The advance of technology is playing an innovative and transformative role in the way coaches, fans and players interact in sport, in terms of management, attendance and sports practice respectively. For the author, technology has a significant impact on boosting efficiency, attractiveness and sustainability in the sports sector (Valente, 2018).

2.1.1. Areas Influenced by the Applicability of Technology

Improving performance is one of the main areas influenced by technology. The use of performance monitoring systems are examples of technologies that allow athletes to accurately monitor their physical condition. These devices help to optimize training processes, bringing them closer to the optimum state for competing and promoting better sporting results (Valente, 2018).

As far as training methodologies are concerned, the integration of data analysis is of paramount importance. Using statistical data allows coaches and players to better understand the effectiveness of different strategies. Analysing game information, such as the accuracy of specific actions, makes it possible to improve individual and collective tactics based on empirical evidence, which can have a significant influence on competition results. Liebermann et al. (2002) emphasises the importance of multiple feedback systems that include visual, auditory and proprioceptive technologies, which play a role in evaluating athletes' performance. Through these systems it is possible to increase the likelihood of learning and improvement by comparing actual performance with expected results.

According to Valente (2018), the development of sports equipment benefits considerably from technology. Technological innovations have led to the creation of specialised equipment that enhances sports performance and therefore the evolution of various contexts. For example, in cycling, the introduction of feedback systems during training has shown significant improvements in race times. Another example is roller hockey, where the use of technology in the manufacture of skates, including boots, bases, wheels and bearings, results in a finished product that is lighter, more compact and faster, directly influencing the speed of the game as well as its safety. Also in this area, Seçkin et al. (2023) states that wearable technology has a direct impact on improving performance and training methodologies.

The integration of mixed and augmented reality (AR) influences sports areas such as athlete training, fan engagement, broadcasting and marketing strategies. These technologies are used to monitor and optimise performance and injury prevention through specialised simulators. It also makes it possible to bring sports action closer to fans, both in stadiums and on television broadcasts, through interactive applications and real-time data overlay (Sawan et al., 2020). AR strengthens the marketing area by boosting new forms of revenue, as it allows for a greater range of interactions, especially catapulted during the Covid-19 pandemic, when digital alternatives were key to connecting with the public (Sawan et al., 2020).

Data management and processing is also playing a central role in modern sport. The use of information systems allows large volumes of data to be collected and analysed, which is essential for strategic decision-making. This data is used in the decision-making processes of the various technical teams and staff, as well as in the definition of playing strategies and the prevention and treatment of injuries, making it an indispensable tool for sporting success. Kampakis (2016) considers that analysing large amounts of data helps to identify and understand injury risk factors as well as the respective recovery times, through the use of GPS during training or competition. Rossi et al. (2018) also links data processing to injury prevention through Electronic Performance and Tracking Systems (EPTS). This technology is responsible for the reliable collection of data during sporting activity, capable of analysing the performance of athletes by recording movements, physical efforts and workloads.

The involvement of fans is not unrelated to the direct impact of technology. The development of interactive applications and advances in broadcasting techniques offer a more immersive and dynamic experience for the public. This greater interaction plays a decisive role in boosting financial revenue for the various sporting bodies by contributing to increased attendance at sporting events and growing audiences, strengthening the link between fans and their favourite sports. Kiani and Nazari (2022) consider that the use of information and communication technologies (ICT) enables better interaction between technology and sports fans. In this way, it is possible to involve information updated in real time and personalised content through various platforms, such as social networks. Through information systems, sports organisations can better understand the behaviour and preferences of fans, thus boosting the development and improvement of communication and the production of relationships by providing engaging experiences with the aim of solidifying customer loyalty and the corresponding turnout at sports venues.

2.2. Business Intelligence

2.2.1. BI Definition

For Chee et al. (2009), Business Intelligence (BI) is defined as the process of changing data into information and then into knowledge. It encompasses various technologies and systems responsible for collecting, storing and analysing large amounts of data to aid the decision-making process in organisations.

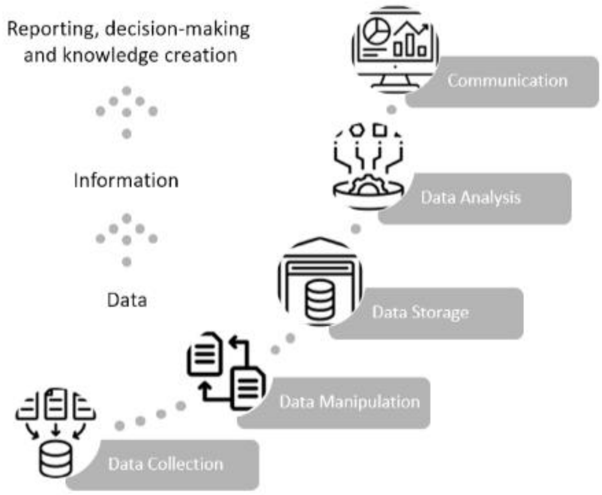

Figure 1 - BI data-related process adapted from (Foley and Guillemette, 2010)

Barbieri et al. (2024) defines BI as the combination of processes, policies, culture and technologies to collect, manipulate, store and analyse data gathered from internal and external sources in order to communicate information, create knowledge and inform decision-making.

Some of the different concepts and definitions of BI in the literature can also be seen in Table 1:

Table 1 - BI concepts in the literature

Author	BI Concepts
(Vercellis, 2011, p. 3)	'It can be defined as the support of mathematical models and analysis methodologies that exploit available data to generate information and knowledge for complex decision-making processes.'
(Azevedo & Santos, 2009)	'... is the application of a set of techniques and tools that are proposed to assist in the management of a business and in decision-making.'

(Botelho & Filho, 2014, p. 6)	‘BI is the set of applications, tools and methodologies used to collect, process, store, retrieve and disseminate information in order to assist the process of making complex organisational decisions.’
(Hu et al., 2014)	‘BI provides a set of methodologies, processes, architectures and technologies that transform raw data into valuable information to enable more effective strategic, tactical and operational vision and more effective operations.’
(Gupta et al., 2015)	‘BI is a term for applications, technologies, architectures and processes used to collect, store, retrieve and analyse operational data.’
(Sharda et al., 2014)	‘BI systems monitor situations and identify problems and/or opportunities using analytical methods.’
(Turban et al., 2008, p. 8)	‘BI is a generic term that combines architectures, tools, databases, analytical tools, applications and methodologies.’
(Tavera Romero et al., 2021, p. 1)	‘... BI is playing an increasingly critical role in various types of companies because, as information has been identified as a company's most valuable asset, it is a fundamental resource for its development.’

After presenting the various concepts in the literature, it is possible to conclude that Business Intelligence (BI) encompasses the combination of processes, methodologies, architectures and technologies for collecting, storing, processing and analysing data from internal and external sources within organisations. The main objective is to help make strategic, tactical and operational decisions within organisations by transforming data. To do this, BI uses mathematical models, analytical tools and methodologies to monitor scenarios, identify problems and opportunities, and streamline and optimise organisational management.

2.2.2. BI EVOLUTION

The evolution of BI mirrors the process of constant transformation of organisational practices stimulated by the progress of technology and the need for decision-making based on data and information. Initially, BI emerged as a set of decision support systems (DSS) focused on organizing and analysing structured data to help managers (Turban et al., 2008). Later, the integration of emerging technologies such as data warehouses, data mining and online analytical processing (OLAP) significantly expanded its capacity to analyse more sophisticated predictive scenarios (Sharda et al., 2014).

Over the last decade, the evolution of BI has seen the adaptation of technologies such as Big Data Analytics, cloud computing and artificial intelligence, making it a key component of data-driven organisational strategies (Gupta et al., 2015; Hu et al., 2014). This transformation process makes it possible to customise analytics to the needs of organisations, as well as massively processing information in real time (Tavera Romero et al., 2021).

According to the analysis by Marjanovic & Dinter (2018), it was possible to draw up a historical chronology of the development of BI.

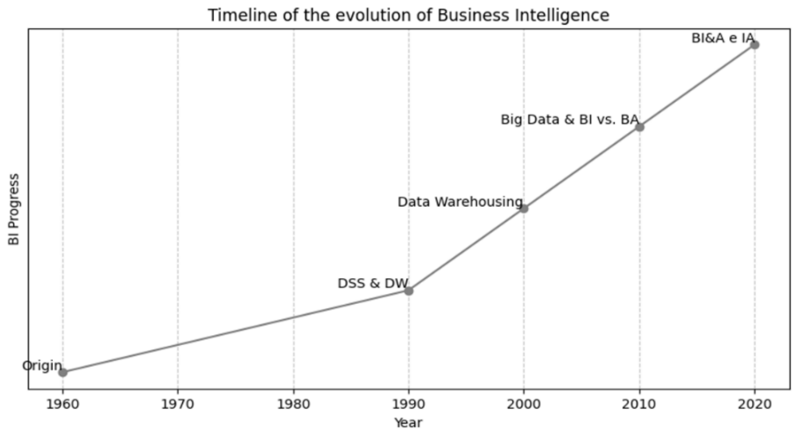

Figure 2 - Evolution of BI based on Marjanovic & Dinter (2018)

Table 2 - BI evolution and developments

Period	Key Developments	Technological Concepts
1960´s Origin	The emergence of Decision Support Systems (DSS) to help make data-based decisions.	Initial computational data analysis.
1980´s – 1990´s	Evolution of BI with the introduction of Data Warehousing (DW) and Executive Information Systems (EIS).	Centralised data storage, structured reporting.
2000´s	Transition from DSS to Enterprise Data Warehouses (EDW) and real-time data warehouses.	Large-scale data management, real-time processing.
2010´s Big Data Expansion	Introduction to Big Data analysis.	Unstructured data processing, AI, Machine learning.
2020s	Holistic approach to Business Intelligence & Analytics, including descriptive, predictive and prescriptive analysis	Information from AI, BI in the cloud, real-time analysis

Nowadays, BI is a dynamic tool capable of carrying out real-time analysis and developing predictive models. the modern strategy of organisations. Its permanent integration with the exploitation of Big Data adjusts the modern strategy of organisations, which, by exploring and understanding consumer trends and behaviour, adjust their way of operating, prospering and competing in the current market environment, which is increasingly characterised by the enrichment and complexity of data. There has also been an evolution in existing platforms capable of providing a comprehensive view of various operational scenarios. These platforms include dashboards and interactive visual representations resulting from complex data analysis, where end users can easily interpret key performance indicators (KPIs) and various scenarios and trends to improve and understand certain planning and decision-making processes (Adewusi et al., 2024).

Adewusi et al. (2024) warns that there are new challenges in the current landscape of organisations in terms of the shortage of qualified professionals, guaranteeing data quality and data security. Veldkamp (2023) assures us that data represents a competitive advantage and is increasingly becoming an asset in organisations due to its vast potential to generate information capable of predicting opportunities, reducing risks and playing an important role in the continuity of technological development.

2.2.3. BI Approaches

The significant evolution of BI mentioned above has led to the emergence of new technologies and methodologies. Traditional BI, operational BI, self-service BI (SSBI), integrative data analysis, analysis and machine learning are the different approaches, each adapted to different organisational contexts and levels of analytical maturity, discussed by Vo et al. (2017).

Vo et al. (2017) considers that traditional BI systems essentially focus on the processes of collecting, extracting and organizing data in order to obtain efficient query processing with the aim of achieving results and information based on historical data. This type of system usually uses three-tier architectures, each corresponding to a presentation layer, an application layer and a database layer. Slow processing, rigidity and complex maintenance are considered disadvantages of traditional BI systems.

According to Chen et al. (2012), Operational BI is characterized by its agility and ability to process and analysis large volumes of data in real time, from various sources, to support immediate operational decisions. Because this system is directly connected to the organisation's operational systems, alignment with internal processes and the reliability and consistency of the data are guaranteed, since no arbitrary changes are allowed (Zimmer et al., 2012). The same author points out that this approach arises from the need to adhere to structures that help manage IT services, limited to a governance domain and principles defined by organisations, such as ITIL and COBIT. Schläfke et al. (2012) consider that operational BI is supported by precise performance metrics to boost and monitor the organisation's efficiency. They therefore suggest a structured framework that considers business analytics elements and various performance factors, with the aim of facilitating and clarifying processes for organizing and analysing data, for example in marketing areas related to demand forecasts and effectiveness evaluations.

Self-service BI (SSBI) is, according to Alpar and Schulz (2016), an approach that empowers non-expert users to access, analyse data, create reports and dashboards autonomously, without relying exclusively on IT teams. However, Lennerholt et al. (2018) recognises significant challenges related to data governance issues and data quality, acknowledging the need for adequate training so that users can exploit the tools self-sufficiently and effectively. The fact that end users can directly access the tools and achieve answers to the organisations' needs represents an advantage by reducing the burden on IT teams, but Schlesinger and Rahman (2016) warn that the quality of the data and its security may be compromised.

Integrative Data Analysis (IDA) is a methodological approach that makes it possible to carry out an analysis of a single group of combined data from various sources with the aim of understanding a particular phenomenon (Hossain et al., 2024). The same author mentions that by increasing the size of the data set, ADI considers the variability of different approaches, which makes it obvious to improve the statistical significance of the analysis, thus avoiding fragmentation and scarcity of data. Curran and Hussong (2009) identify in this approach the advantage of being able to obtain comprehensive conclusions and results from several diverse data sets, however they consider as a challenge the incompatibility of the data resulting from the differences in methodologies of the various original sets.

Bharadiya (2023) argues that the Machine Learning (ML) approach can be interpreted as transformative in the BI domain. The process of data collection, selected data extraction from various sources and feature engineering in data pre-processing are significantly streamlined and improved with the ML approach. It is thus possible to reduce the dimensionality of the samples into filtered content that is useful and essential for the users' objectives. The author also considers predictive analytics to be the backbone of ML, as historical data and statistical algorithms such as decision trees and neural networks, among others, are used to predict future scenarios, such as operating results, customer behaviour or market trends. Selvarajan (2020) considers the usability and exploitation of ML to be an asset for organisations, as it is possible to record detailed customer profiles and adjust marketing strategy processes to increase customer satisfaction. Reshi and Khan (2014) define that this approach becomes beneficial when the algorithms are appropriate to the context of the scenarios and the quality of the data is guaranteed, clear and relevant, to facilitate the integration process. Other difficulties mentioned by the authors are the complexity of implementation and scalability problems, as this approach requires resources with specialised knowledge in organisations' IT teams and requires significant investment in infrastructures that support larger-scale ML and BI models to keep up with the growth of existing data.

2.3. Business Intelligence and Healthcare Sector Relationship

2.3.1. Introduction

The implementation of BI in the healthcare sector aims to improve operational efficiency and services provided to patients, through practices and applications of data collection, integration, analysis and presentation (Tapia et al., 2020). Authors Loewen & Roudsari (2017) consider BI an emerging factor in the health focus and state that the provision of health care is improving with the use and exploration of clinical information systems by providing results to managers and those responsible for health systems when they are able and capable of interpreting the data available through the systems. One of the main advances in BI is the development of real-time analysis solutions, facilitating immediate access and respective data analysis, capable of assisting the preventive decision-making process (Ali et al., 2016)

Pestana et al. (2020) states that a quality healthcare service requires the interconnection of information, allocated from different sources, relating to patients, so that it can be made available to all professionals in the sector. Medical infrastructures store a large amount of data over the years, particularly in recent years in digital format, which highlights the possibility of exploring and analysing all types of information from a clinical, financial and even laboratory data point of view (Kawamura et al., 2014).

2.3.2. Applicability

BI tools have considerable applicability when it comes to data consolidation, adaptability, and access to complete and personalized information on fact-based practices, assisting management and the respective results and decision-making in the health sector (Torres et al., 2021). The tools mentioned by Chen et al. (2012) and Brandão et al. (2016) such as QlikView, Microsoft, IBM, Tableau, Oracle and SAP, enable the performance of personalized and specific research, the analysis of reports and queries, control panels, interactive visualization, as well as data mining and predictive modelling. Clinical data sets provide an excellent environment in which combined analyses of structured and unstructured data can prove productive and useful (Bonney, 2013).

Torres et al. (2021) enhances the systematic application of BI solutions in the healthcare sector, such as data visualizations and reporting. These tools allow the creation of graphs and lists with the aim of streamlining results and work processes, such as monitoring and evaluation tasks. BI technology empowers users, giving them the autonomy to create reports and perform analyses independently (Bonney, 2013).

Bonney (2013) highlights the importance of response capacity in the health sector in emergency situations, in which speed is required in the decision-making process by the professionals involved, when accessing immediate information in real time. The author reinforces the idea that the analysis and exploration of data in this specific sector can positively assist patients' medical records if specific weakened areas, assessments or specific symptoms that require greater focus are identified.

A comprehensive BI maturity model for the healthcare sector should assess areas such as vision and strategy of clinical organisations, management support, change management, human resource skills, data quality and technological infrastructure (Brooks et al., 2013).

2.3.3. Benefits

The integration of BI in the healthcare sector improves performance, efficiency and operational quality, supports decision-making and consequently improves patient well-being (Mettler & Vimarlund, 2009). There are several benefits and advantages seen in implementing BI in the healthcare sector:

Table 3 - BI benefits and concepts

Benefits	Concept	Author
Data accessibility	Professional access to critical data quickly and efficiently.	(Loewen & Roudsari, 2017)
Time optimization	Streamlining processes frees up crucial time for human resources.	(Loewen & Roudsari, 2017)
Real-time information	It allows healthcare organisations to respond to specific demands and ever-changing circumstances.	(Mettler & Vimarlund, 2009)
Improved decision making	Provides pertinent information in a timely manner for both clinical and administrative purposes.	(Loewen & Roudsari, 2017; Mettler & Vimarlund, 2009)
Improved results	Ability to identify trends and areas for improvement in different services.	(Loewen & Roudsari, 2017)
Online Analytics and Ad Hoc Query Processing	Allows users to perform personalized and specific analyses and queries for certain contexts.	(Ratia et al., 2017)
Evidence-Based Practice Support	Patients benefit from better outcomes by understanding correlations between datasets.	(Mettler & Vimarlund, 2009)
Improved financial performance	Identification of opportunities, cost reduction and optimization of resource allocation.	(Loewen & Roudsari, 2017)

Quality and Safety Measurement	Measuring results ensures cohesive work between multidisciplinary teams to achieve common objectives.	(Mettler & Vimarlund, 2009)
Collaboration between health entities	Connectivity between different infrastructures in the healthcare sector. Sharing documents and information.	(Loewen & Roudsari, 2017; Mettler & Vimarlund, 2009)

2.3.4. CHALLENGES AND IMPLEMENTATION

The healthcare industry faces unique challenges that make the BI implementation process difficult. The complexities related to clinical and administrative information, patients and data management contribute to the inability of adequate approaches by BI maturity models. This inability can hinder the achievement of clinical infrastructure objectives (Brooks et al., 2013).

Azvine et al. (2005) identified, at the time, the exploration and use of traditional systems as a challenge since they required specialized knowledge. Many solutions relied on pre-built data warehouses and did not support real-time data integration updates, creating a barrier to end-user access to relevant information.

Lennerholt et al. (2018) identifies several critical challenges regarding SSBI (Self-Service BI). When there is a need to access data, users are unable to operate technically independently, which goes against the nature promoted by this scope. Users face difficulties in determining the quality of data when it comes from external sources. Thus, there is a tendency to prepare reports whose results and erroneous information can negatively contribute to the decision-making process. The author reinforces the idea that SSBI is not a simple and easy-to-use scope, while pointing out the need for adequate training for data selection, understanding, interpretability and analysis (Lennerholt et al., 2018).

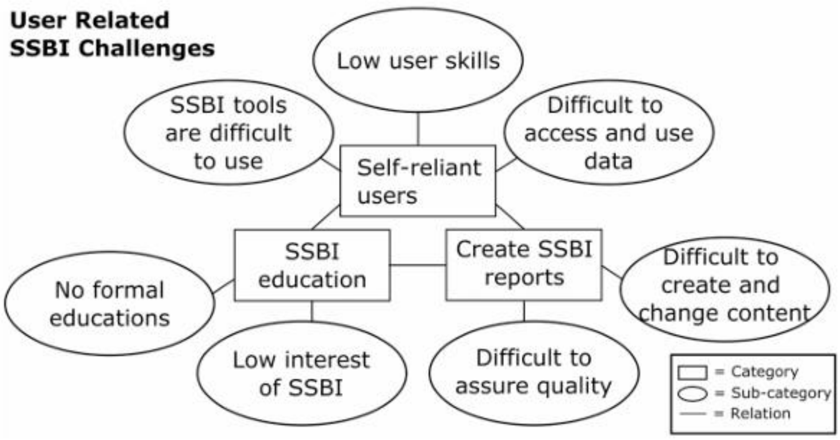

Figure 3 - Categories and sub-categories of user related SSBI challenges (Lennerholt 2018)

3. METHODOLOGY

3.1. DESIGN SCIENCE RESEARCH

The Design Science Research (DSR) methodology focuses on the development and evaluation of artefacts with the aim of solving identified problems. DSR aims to improve and innovate by developing new models, tools, methods and theories, unlike traditional research methods that study and analyse existing phenomena (Peffers et al., 2007). Peffers et al. (2007) argue that this methodology follows an iterative and properly structured approach, ensuring that the evaluation of the artefacts produced is rigorous and relevant.

Hevner (2004) highlights the impact that DSR has on Business Intelligence systems, through the creation of innovative artefacts that make it possible to explore data analysis, analytical models, dashboards and data visualization tools with the aim of aiding decision-making processes.

Peffers et al. (2007) devised the Design Science Research Process (DSRP) model, which is divided into several stages with the aim of guiding researchers towards solving practical problems through a structured approach that consists of designing and developing innovative artefacts.

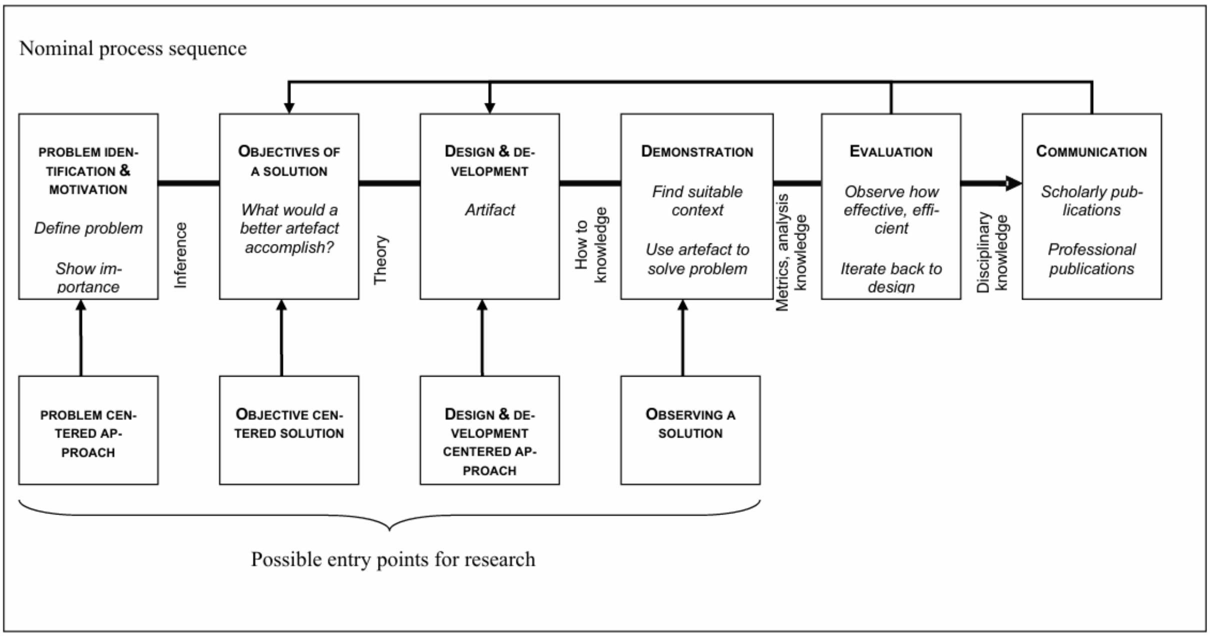

Figure 4 - Design Science Research Process model (Peffers et al. 2007)

Problem identification and motivation is the first orientation of the model suggested by (Peffers et al., 2007). A properly defined and identified problem facilitates the process of developing an effective solution. This step includes understanding the context of the problem and its environment, as well as the various stakeholders involved in the solution. Researchers identify inefficiencies and gaps in existing technologies and justify the reason for the applied study by highlighting the theoretical and practical importance of the problem (Peffers et al., 2007).

Once the problem has been identified, the next step is to define measurable objectives for solving the problem. The objectives defined should specify the goal that the research aims to achieve, always considering alignment with theoretical knowledge and practical applicability (Peffers et al., 2007).

In the design and development phase, the artefact is created. The artefact can take a variety of formats, such as models, frameworks, a particular algorithm or software, a method, process, etc. The format chosen must be suitable and then capable of solving the problem identified in the first phase. The design phase guarantees a solid theoretical basis by identifying the technologies, methodologies or tools needed to develop the artefact. Researchers can use or draw ideas or models from existing literature to strengthen the chosen approaches (Peffers et al., 2007).

The demonstration stage must demonstrate the applicability of the artefact developed in a real context. This phase aims to prove that the artefact developed demonstrates the ability to solve the problem identified through experiments, studies, simulations or pilot tests (Peffers et al., 2007).

The evaluation phase involves measuring the performance of the artefact developed in relation to the defined objectives, using qualitative and quantitative methods. The artefact will be exposed to a demanding evaluation to delimit its effectiveness in the identified problem. The evaluation is carried out using statistical analysis techniques, expert reviews, previous studies with solutions to identical problems and feedback from the artefact's end users. The artefact may be subject to adjustments if gaps or weaknesses are identified during the evaluation phase (Peffers et al., 2007).

The final orientation of the research process involves communicating the results to the interested public, such as professionals involved in the sector studied or the academic field. For research to have a significant record and impact, it is essential that dissemination is effective, explicit and clear in terms of identifying the problem, the research methodology, the artefact and the respective evaluation results (Peffers et al., 2007). Peffers et al. (2007) argue that researchers should emphasise the project's contribution to enriching existing knowledge and literature, as well as identifying future research potential.

Iteration and refinement are the essential phase aimed at improving and enhancing the artefact developed, considering the results of the evaluation and the feedback obtained. The artefact's performance can be improved by identifying existing gaps and limitations. This iterative process guarantees innovation and closeness to the fulfilment of the defined objectives through continuous improvement of the project model (Peffers et al., 2007).

Hevner (2004) reinforces the description of the fundamental guidelines for effective DSR research, defined in Figure 5, in the context of Information Systems. The aim of the guidelines is to clarify the requirements for carrying out scientific research and to help the various stakeholders in the process, such as researchers, reviewers, readers and publishers. In the context of BI, the main objective of this methodology is to respond to specific needs and solve problems identified and contextualised in the respective organisations (Hevner et al., 2004).

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Figure 5 - Design Science Research Guidelines (Hevner 2004)

3.2. DSR Implementation

The applicability of the Design Science Research methodology in this research involves the design, development and evaluation of a Business Intelligence solution in the context of a professional sports club's medical clinic. The Figure 6 shows the model (DRSM) by Peffers et al. (2007) adapted to the research in this project:

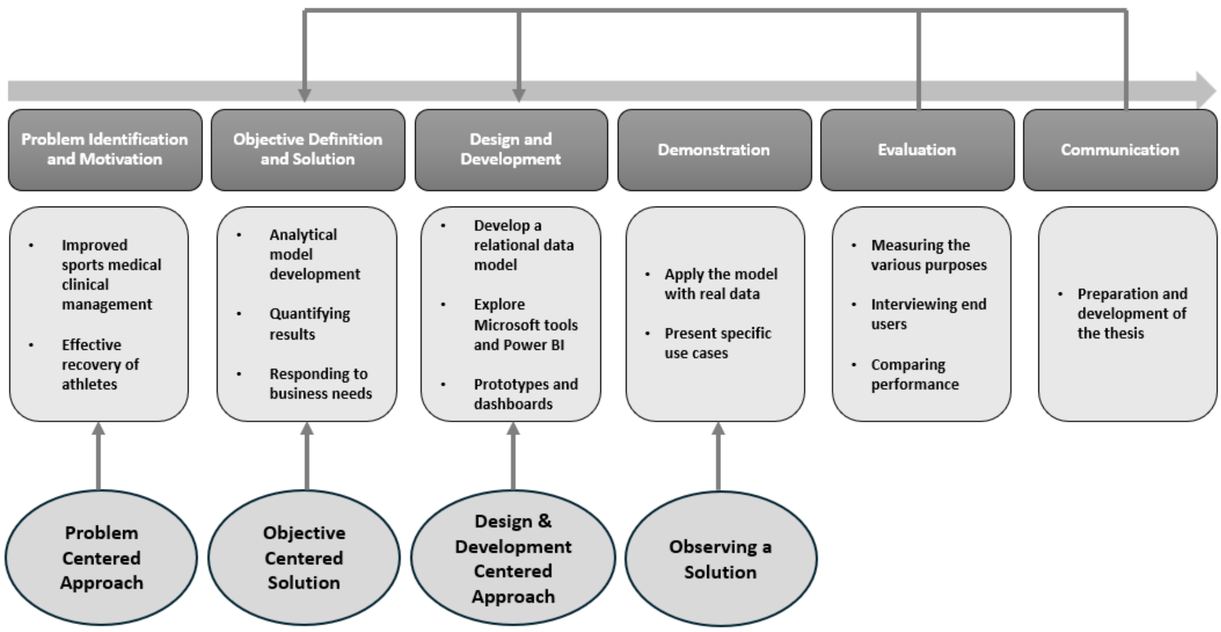

Figure 6 - Design Science Research Implementation

3.2.1. Problem Identification and Motivation

The medical clinic of an eclectic and professional sports club, made up of several hundred athletes from different disciplines, registers several consultations and injuries every day. The efficiency of its operation has a direct and positive impact on the health and performance of athletes (Tenan & Alejo, 2024). The clinic is responsible for the complex monitoring and recording of all stages of the athlete's recovery process, from the first consultation to the last physiotherapy recovery session. The athlete's recovery time is a determining factor for the success of teams in high-level competitions (Everett et al., 2024).

The monitoring of clinical data in sports clubs faces challenges such as the lack of information integration, difficulties in analysing injury patterns and recovery, and the constant need for support capable of aiding the decision-making process of medical and technical teams. Despite the existence of Business Intelligence (BI) tools in the health sector (Ivan & Velicanu, 2015), their specific application in sports medical clinics still requires in-depth research. The reality of sport has unique specificities, as it involves the continuous monitoring of athletes from different disciplines, with specific and diverse clinical needs, and requires a high level of precision in the identification, diagnosis and treatment of injuries.

In this sense, the development and implementation of a relational data model based on BI appears to be an innovative approach to explore and apply in the club's medical clinic. Detailed analysis of clinical data allows trends to be identified, average injury recovery times to be assessed, repeat injuries to be prevented and the average number of treatments per injury identified. The development of interactive dashboards promotes access for end users, such as members of medical and technical teams, to essential information on diagnoses, recovery times and the clinical status of athletes, contributing to more informed, data-based decision-making.

This thesis therefore aims to address the following research question: How can a BI analytical model improve the management and efficiency of a sports club's medical clinic? The development of a relational data model in a star schema will help to understand the solution to the problem identified. This study aims to fill the existing gap in the academic sphere in the application of BI in the management of sports medical clinics, promoting the optimization and usability of the data recorded in the clinic as well as the various pieces of information mentioned above.

3.2.2. Objective Definition and Solution

The main aim of this thesis is to design a BI analytical model with the ability to assign useful and strategic information regarding medical consultations, pathologies, diagnoses and KPIs. Structured data analysis is focused on identifying injuries and the physical recovery of athletes. There is a high level of complexity in terms of the diversity of athletes, sports practiced, and the type of injuries recorded.

The artefact has a star-shaped structure. The data recorded refers to the last 3 seasons, 2022/2023, 2023/2024 and 2024/2025. The development of this model culminates in the creation of interactive analytical dashboards.

The aim of implementing this artefact is to contribute to the sporting success, integrity and good performance of team squads and their athletes by analysing and monitoring rehabilitation processes based on objective evidence. By identifying recurring injuries, this analytical tool stimulates preventive strategies and streamlines clinical planning.

3.2.3. Design and Development

The design and development phase of this project focuses on developing an analytical model based on BI, the aim of which is to explore the data recorded by a sports club's medical clinic.

The model assumes a relational data structure in a star schema and will be developed using the Power BI tool on the Microsoft Fabric platform. This structure allows clinical data to be organized using fact tables and dimension tables. The fact tables store quantitative data and key metrics for the intended analysis, namely the number of medical consultations carried out, diagnoses made and injury recovery times. Dimension tables give context to factual data, in this case containing information on athletes and their teams, medical diagnoses, pathologies, medical specialties and sports disciplines. By relating the data distributed respectively in each table, it is possible to carry out a multidimensional analysis, capable of evaluating and answering the business questions mentioned above.

The tool chosen is Power BI, which is part of the Microsoft Fabric platform. Microsoft Power BI allows users to connect to a wide variety of data sources, whose capacity simplifies the process of agglomerating data for analysis and report creation (Borra, 2024). The use of this tool enables the creation of interactive and dynamic dashboards with several simultaneous visualizations, such as maps, graphs and tables, considering the data analysed in real time (Gonçalves et al., 2023). The sports club's technical and medical teams can consult, interpret and make decisions based on the information provided, organized and structured in the interactive dashboards.

3.2.4. Demonstration

The artefact developed, namely the analytical relational data model, will be applied to real records from the sports club's medical clinic, corresponding to the last 3 seasons. The effectiveness of its usability will be validated when it demonstrates the ability to attribute relevant information to the business questions posed.

To demonstrate the usefulness of the model, a few use cases will be considered, in Table 4, that allow for increased value creation in various clinical processes related to athletes.

Table 4 - Examples of Use Cases

Use Cases	Description
Analysing the distribution of injuries by sport	Identifying specific injury trends for each sport and encouraging the implementation of preventive strategies.
Measurement of average recovery time per identified injury	Evaluation of the impact of various pathologies on the period of physical inactivity and optimisation of rehabilitation processes.
Comparison of injuries between different sports disciplines	To analyse the existence of injuries in the various sports and identify which require greater attention or mobilisation of medical resources.
Seasonal trends in consultations and injuries	Analysing the existence of periods with a higher incidence of certain injuries allows sports planning to be adjusted and adapted.

The use cases of Table 4 can be presented through interactive visualisations with detailed information. In this way the relational data analytics model can be applied in a real way in the sports organisation with the aim of creating value for the sport's medical clinic.

3.2.5. Evaluation

The purpose of this stage is to verify the practical usability of the model, as well as the applicability of the dashboards and their results in the real context of the sports organisation. In this way we will be able to quantify the benefits and validate whether the artefact developed makes a positive contribution to the management of clinical information and whether it satisfies the various end users such as doctors, physiotherapists, physiologists and sports technical teams.

The model's accuracy will be measured by comparing the examined data with real clinical records. The data consistency verification process is characterized by certifying that the values shown on the dashboards correspond to the actual information recorded by the clinic. To guarantee the quality of the metrics and key performance indicators (KPIs), an assessment is made of the indicators calculated and their correspondence to the real context. It is extremely important that quick access and easy usability are guaranteed, to classify the artefact's navigation as intuitive and dynamic.

Experimental tests will be carried out with end users, as mentioned above, doctors, physiotherapists, physiologists and members of the technical staff (coaches and assistant coaches). The evaluation process involves a system demonstration plan in which the functionalities of the dashboards will be explained, practical tests to promote user interaction with the platform, collection of feedback through a questionnaire and direct observation of the use of the dashboards, identification of improvements, suggestions, adjustments and redesign of the model if certain gaps or flaws in the system are identified.

The evaluation phase also includes a comparison between the performance of the clinical process before and after the implementation of the model. The comparison analysis should be made up of indicators such as the average recovery time of athletes before and after the use and exploitation of the model, the satisfaction of end users with access to clinical information, the impact on the various decision-making processes and the efficiency in identifying patterns and trends in various types of injury.

3.2.6. Communication

The communication phase involves documenting and publicising the results obtained from this project. The aim of this stage is to ensure that the research is shared with the scientific community and professionals in the medical and sports fields.

The master's thesis contains the necessary structure to present the process of development, validation and impact of the artefact. In addition to drawing up the document, the artefact can be assigned, explored and developed by the sports organisation involved in this research.

4. EMPIRICAL STUDY

This chapter shows all the stages of the process of creating the artefact, from the collection of data provided by the Sports Club analysed, to the creation of the dashboard tested and evaluated by end-users of the sports organisation. The contextualisation of the case study, the development and definition of the business needs, the description and analysis of the architecture developed, the development of the entire ETL process, the relational and multidimensional data model and the development and analysis of the reports and dashboards will be covered.

4.1. CASE STUDY CONTEXT

One of the best sports clubs in the world today operates successfully in the organisational and business, technological, social and financial spheres, as well as in the areas of communication and health and well-being. It is precisely in the areas of health and wellbeing and technology that this thesis will focus.

The sports club has a well-developed medical department comprising dozens of professionals specialised in the most diverse areas of health and research, designed to successfully assist the needs and performance of hundreds of athletes and employees.

Every day, the club's medical clinic records the various consultations carried out by doctors. The records contain information on the type of consultation carried out, the injuries identified and their detailed description, as well as the players seen. In addition to the medical consultations carried out at the clinic, the various physiotherapy and injury recovery sessions are also recorded in the system on a digital platform that is transversal and private to the medical department. Considering the reasons for privacy and data protection policies, it was decided, together with the heads of the sports organisation's IT department, to restrict the provision of data in terms of the number of sports and teams. It was decided to keep the identification of athletes anonymous, i.e. their names are not included in the data, but rather an ID is assigned to each one, with the respective information attached.

The data obtained for this research covers the dates of 1st July 2022 and 2nd January 2025, i.e. the 2022/2023, 2023/2024 and 2024/2025 seasons (in progress at the time of writing). In 2732 medical consultations, 482 male and female athletes from the 19 senior handball, basketball, futsal, roller hockey and volleyball teams were considered. A total of 783 injuries were recorded and analysed. The data provided contains 1852 different Osics codes (codes with 4 capital letters that identify the specificity of the injury by anatomical area), with a total of 25 anatomical regions.

Table 5 - Events recorded and their quantity

Sports Disciplines	5
Teams	19
Players	482
Sports Seasons	3
Medical Consultations	2732
Total Recorded Injuries	783
Osics Codes	1852
Anatomical Regions	25

4.2. DEFINITION OF BUSINESS NEEDS

The first stage of designing the artefact involves identifying the business needs of the sports medicine clinic. The requirements were considered, discussed and defined in close collaboration and agreement with the main stakeholders in the medical department and the organisation's IT department, namely doctors, physiotherapists, physiologists, clinic managers and the club's data analysts. The aim of this stage is to ensure that the proposed BI solution is connected and perfectly aligned with the real need to analyse, monitor and support decision-making by streamlining the management of athletes' clinical information.

Throughout the meetings with the various professionals involved, the following four primary business needs were identified:

4.2.1. IDENTIFYING THE TOP 10 INJURIES BY SPORT

Some of the professionals involved, such as doctors and physiotherapists, were particularly interested in having an interactive and factual analysis of the main injuries affecting athletes, segmented by sport. This information allows the medical and technical teams of the various disciplines to distinguish between common sense and empirical knowledge regarding the injuries contracted, thus improving the planning and strategic process of prevention and reducing the risk of dominant injuries.

4.2.2. CALCULATING AVERAGE RECOVERY TIMES PER INJURY

Monitoring the average recovery time of identified injuries plays a key role in the development of the analysis. This metric is essential for medical and technical teams when planning medical rehabilitation and predicting how long athletes will be unavailable for competition.

4.2.3. Analysing the average number of medical consultations per injury

This analysis aims to quantify the clinical effort associated with each type of injury through the average number of medical consultations carried out during the recovery process. This measure can help improve the clinic's management and planning, in terms of resource allocation and response needs.

4.2.4. Identifying lesions with potential classification problems

The reliability of this analysis was a topic that was addressed and discussed, due to the integrity and veracity of the data acquired. Inconsistent data classification is a real, constant and cross-cutting challenge in many organisations (Newhouse et al., 2023). Nowadays, the importance of data in the sphere of sport is assumed by all those involved, whose data depends on their transparency and assiduity when filling in the appropriate platforms. The data acquired for this thesis comes from records kept by doctors, physiotherapists, physiologists, etc. This makes it clear that there is a need to identify possible inconsistencies in the records, such as misclassified injuries or gaps in information. The aim is to guarantee the reliability of future analyses.

4.3. Architecture of the System Developed

The artefact developed for the sports medicine clinic is based on modern architecture, entirely developed on the Microsoft Fabric platform. The model was designed to support the flow of data, from the ingestion phase to the display of data analysis through dashboards aimed at clinical and sports stakeholders.

4.4. ETL process

As mentioned above, the data used originates from an internal system belonging to the organisation, where the various professional medical and sports teams record information on consultations, diagnoses, treatments, etc. The data extractions were provided by the organisation's IT department in the form of Excel tables, organised and structured in accordance with the operational information recorded. All the tables were then loaded into a Lakehouse created on the Microsoft Fabric platform, which served as a central repository for the raw data. This stage served as the initial layer of the data pipeline in a secure and flexible manner.

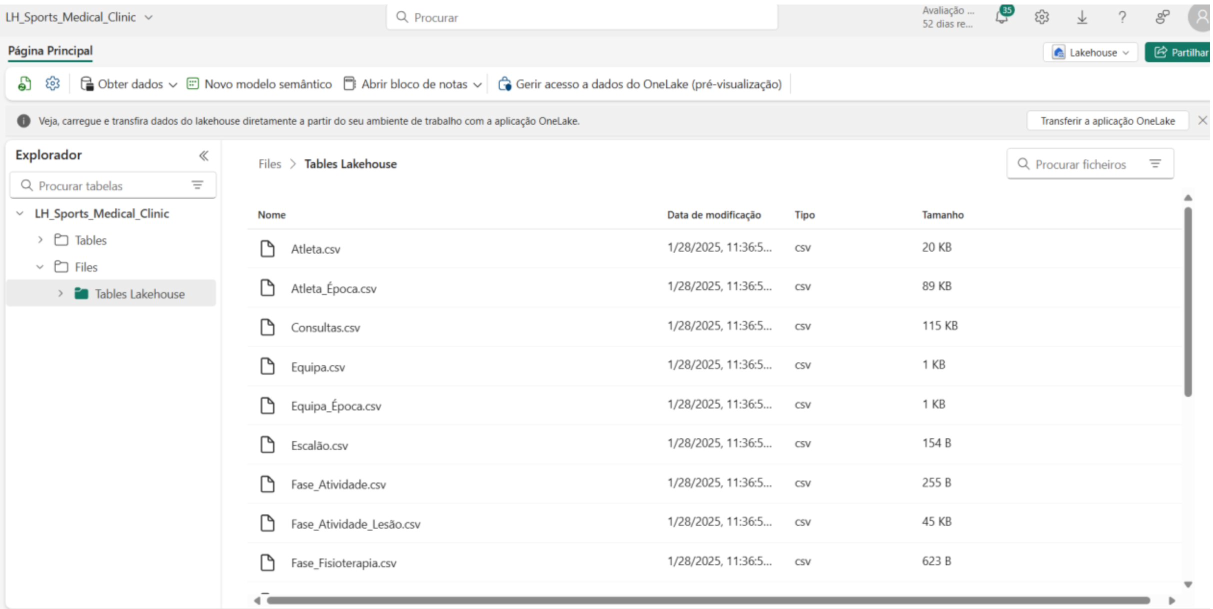

Figure 7 - Lakehouse LH_Sports_Medical_Clinic

Subsequently, a Staging Area was created in the Data Warehouse (DW), which received the data extracted from the Lakehouse. This intermediate area was essential for applying the necessary treatments and transformations, such as normalising data, standardising data types, creating new columns and cleaning up inconsistent or null values. As the Figure 8 shows, at this stage we have many dimension and fact tables, which makes the process of creating a Star Schema model difficult. There was a shortage of information in some tables, which is why the model had to be 'simplified' by joining tables and aggregating information.

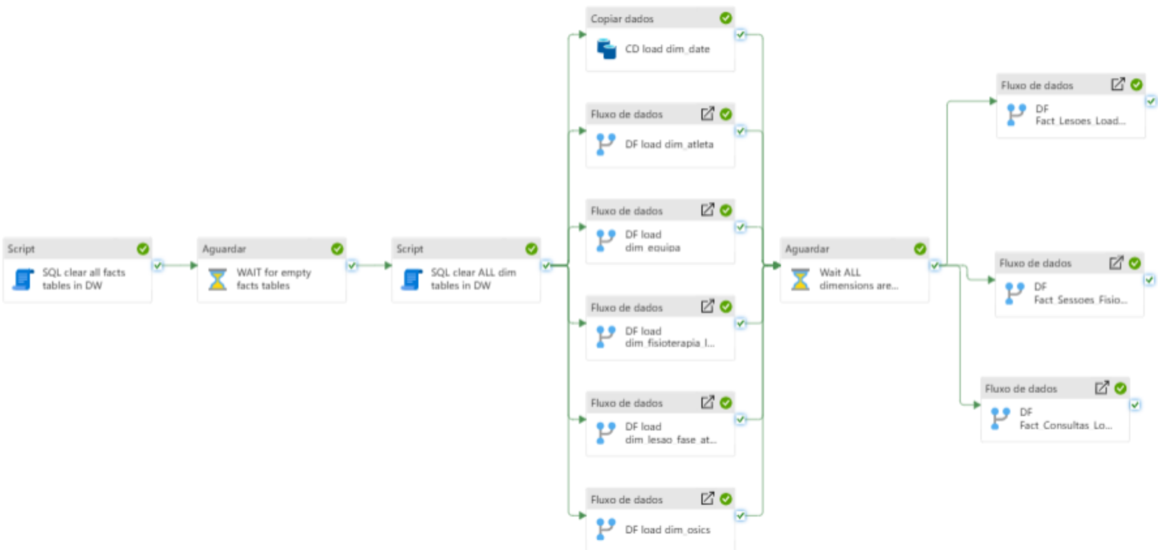

Figure 8 - PL_Sports_Medical_Clinic_LOAD_DW

In the Data Warehouse, a simplified dimensional model was created, based on a Star Schema, consisting of two fact tables, fact_lesoes and fact_consultations, and five-dimension tables, dim_date, dim_athlete, dim_team, dim_osics. By choice at this stage, other dimension and fact tables with information on sessions and events in the field of physiotherapy and physiology are inactive in the model. This model ensures a high level of interpretation of the analysis corresponding to the business questions defined above. Below is the identification and characterisation of all the tables mentioned and the data corresponding to each existing table in the DW prepared to start the analytical process.

4.4.1. DIM_ATLETA

The dim_atleta table in the following figure is the result of the interleaving of the dim_nacionalidade and dim_atleta_epoca tables. The table dim_atleta aggregates all possible information provided by the sports organisation regarding the player. For reasons of privacy and data protection policies, athlete identifications are anonymised and distinguished by identification codes. In this table we have information on gender, nationality, number of years at the club, and dates of the different seasons the player has competed for the club.

4.4.2. DIM_DATE

The dim_date time dimension was the only table in the dimensional model that did not originate in Lakehouse but was built from scratch directly on the Microsoft Fabric platform. For this purpose, the Dataflow Gen2 component was used, through which a complete set of dates and derived temporal attributes were developed, which are fundamental for supporting the temporal analysis of clinical and operational data. The table structure was created based on an SQL script that defined a surrogate key, as well as various descriptive and hierarchical attributes related to days, weeks, months, quarters and years.

The inclusion of dim_date in the model is essential to allow aggregate analyses over time, such as the monthly evolution of injuries, the volume of consultations per year and average recovery times for customised time periods. This dimension also facilitates the creation of temporal hierarchies, dynamic and interactive filters in the reports, adding analytical value to the Business Intelligence model developed.

4.4.3. DIM_EQUIPA

The dim_equipa was stocked with information from the dim_escalao, dim_modalidade and dim_equipa_epoca tables, to contain all the information corresponding to the teams. This table has the particularity of identifying all the senior men's and women's squads in 5 sports over a period of 3 seasons. Some sports have different senior squads, such as ‘B’ teams (usually made up of youth players competing in lower divisions), ‘Sub23’ teams (players under the age of 23), “Sub21” teams (players under the age of 21) and ‘Sub20’ teams (players under the age of 20).

This dimension allows all injury records and consultations to be contextualised according to the team, sport and season to which the athletes belong, as well as segmenting and analysing clinical information according to multiple sporting perspectives. The table's architecture allows for the creation of personalised filters in the final reports through descriptive attributes such as the team abbreviation, time interval, season name and the various identifiers of sports squads.

4.4.4. DIM_OSICS

The dim_osics dimension is a crucial element in the developed model, as it makes it possible to clinically analyse and categorise the various types of injury that occur and are recorded within the sports club. The table organises all the OSICS codes, the meaning of which is standardised medical coding ordered by anatomical area made up of four capital letters, which are recorded directly by health professionals in the organisation's internal system. These codes accurately identify the anatomical area affected, the type of injury and its degree of specificity, and are therefore essential for complex and rigorous clinical classification.

Integrating this dimension into the dimensional model makes it possible to analyse injury patterns in detail, such as identifying the anatomical regions most affected by sport or by season, checking the frequency of specific injuries and even detecting potential classification errors. The attributes present in the table, such as Region, Parent, Specificity and Lay_Description, enrich the granularity of the table and contribute to a descriptive analysis not only for clinical decision support, but also for injury prevention initiatives, resource planning and continuous improvement of data recording quality.

4.4.5. DIM_FISIOTERAPIA_LESAO

The dim_fisioterapia_lesao dimension represents the 5 physiotherapy phases associated with the recovery process from an injury. This table distinguishes each treatment phase as pre-surgical, acute, sub-acute, initial functional, advanced functional and post-integration into training without limitations. This table makes it possible to segment the athlete's clinical journey over time, from the time of the injury to their reintegration into sport.

4.4.6. DIM_LESAO_FASE_ATIVIDADE

The dim_lesao_fase_actividade dimension plays a fundamental role in characterising the athlete's functional state throughout the recovery process, making it possible to identify the phase of physical activity they are in after an injury. This dimension distinguishes seven progressive phases, ranging from ‘inactivity’ to ‘evaluation’, reflecting the athlete's degree of physical involvement throughout the rehabilitation plan. These phases are closely monitored by the areas of physiotherapy and physiology and are crucial for monitoring the athlete's progress and physical readiness.

4.4.7. FACT_LESOES

The fact_lesoes table is the main analytical core of the proposed model, aggregating all the unique injury events recorded over the last three sports seasons. This fact table is linked to the main dimensions, dim_date, dim_osics, dim_atleta and dim_equipa, which makes it possible to contextualise each injury over time, identify the athlete affected and the team and sport involved, as well as the clinical nature of the injury.

4.4.8. FACT_CONSULTAS

The fact_consultas table complements the analytical model by providing a detailed overview of the frequency, distribution and clinical context of medical consultations for sports injuries. Each record in this table represents a single consultation associated with a specific injury, making it possible to analyse the intensity of clinical follow-up over time and by athlete, type of injury, team or sport.

This fact table is linked to the main dimensions such as and to fact_lesoes itself, allowing relevant calculations such as the average number of consultations per injury, or the volume of care per season. The fact_consultas table is important for evaluating the efficiency of clinical management by identifying cases for intensive follow-up and supporting the allocation of medical resources, as well as helping to monitor the quality of the athlete's recovery process.

4.4.9. FACT_SESSOES_FISIOTERAPIA

The fact_fisioterapia_sessoes table records all physiotherapy sessions carried out as part of injury recovery. It enriches model and data storage by becoming another aspect of clinical and operational analysis. Each row corresponds to a specific session, making it possible to identify the athlete, the associated injury, the Osics code of the pathology treated and the date of the session.

Although this table is not directly aligned with the business needs defined above, it represents significant analytical potential for future developments, particularly in assessing the therapeutic load by type of injury and identifying recovery patterns or trends by athlete or team. Its integration into the model guarantees the scalability of the Business Intelligence solution.

4.5. DASHBOARD AND REPORT DEVELOPMENT

Next, a semantic model was developed within Microsoft Fabric, which aggregated the clinic's needs, the relationships between tables, the analytical measures developed by the query and programming language for Microsoft PowerBI table models called DAX (Data Analysis Expressions), and any navigation hierarchies. This semantic model was fundamental to the design and development of the reports and dashboards in Power BI, guaranteeing consistent access to information by end users in an efficient and interactive way.

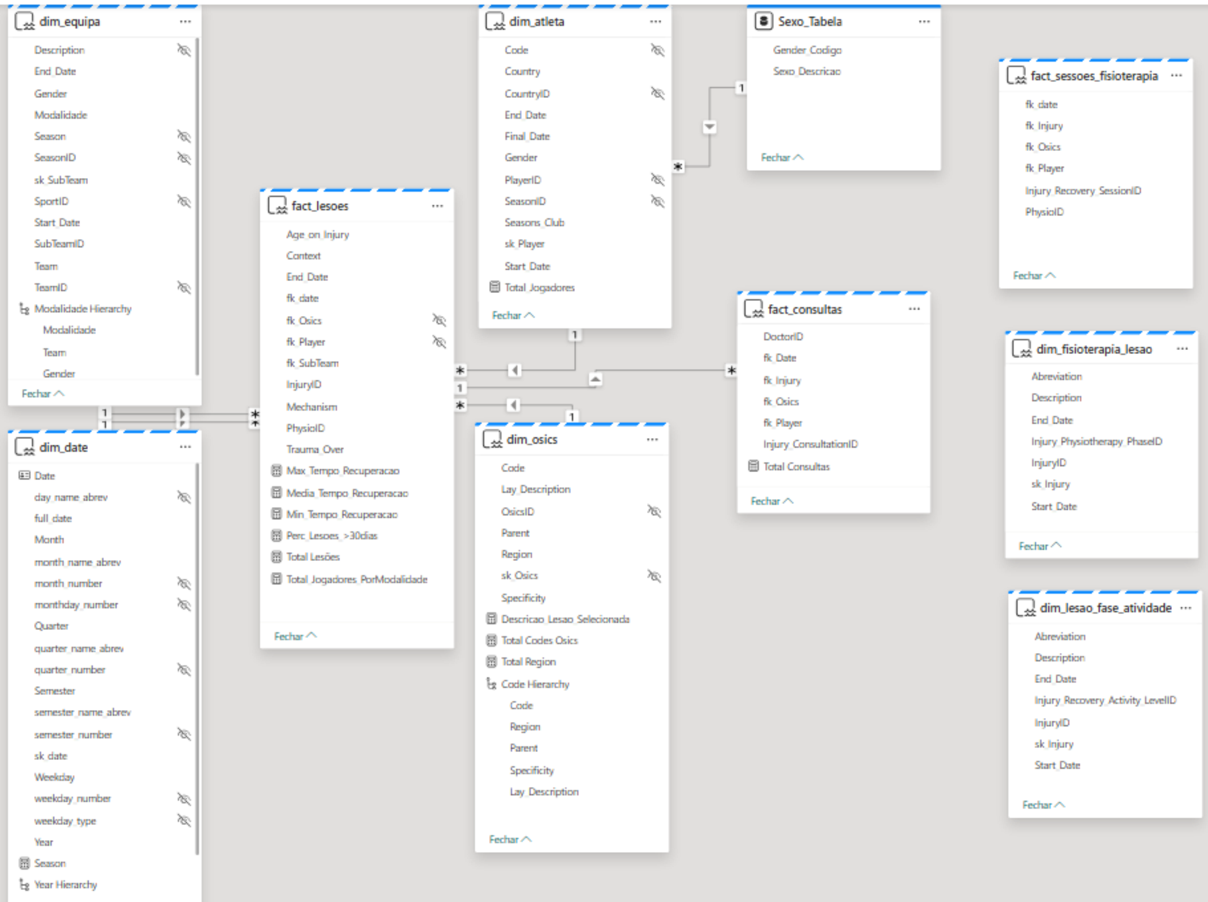

Figure 9 - Sports_Medical_Clinic_SM Semantic Model

Finally, the reports developed in Power BI were published in specific Microsoft Fabric workspaces, guaranteeing the controlled sharing of information and respecting good data governance practices. These reports respond to previously identified business needs, such as identifying the most common injuries by sport, average recovery times, the average number of consultations by type of injury and the detection of potential incorrect injury classifications.

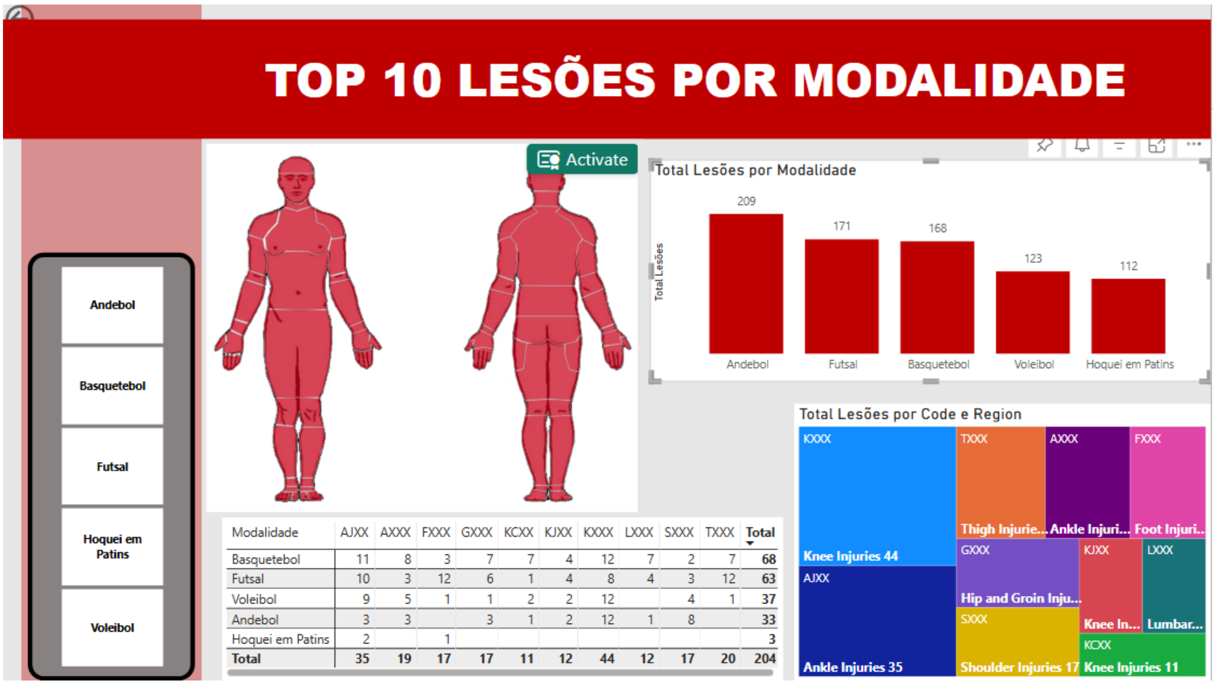

Figure 10 – Page 1 (Top 10 Injuries by Sport)

The Figure 10 represents the first page of the dashboard, entitled 'Top 10 Injuries by Sport', and aims to present a comparative and detailed view of the most frequent injuries by sport. The visual composition helps to answer the first business need identified. The analysis cross-references the frequency of injuries with anatomical location, which allows for a multidimensional interpretation of clinical data.

At the top right, a bar graph shows the total volume of injuries by sport. Andebol is the most affected sport, followed by Futsal and Basquetebol. The tabular matrix in the center relates the OSICS codes to each sport and shows the distribution of injuries by anatomical region, for example, the code AJXX (ankle injuries) appears recurrently in almost all sports. The visual representation of the human body in the center reinforces the spatial analysis by illustrating the most injured anatomical areas.

Finally, the tree map graphic (bottom right) details the total number of injuries by code and region, highlighting the predominant injury groups, such as knee (KXXX) and thigh (TXXX) injuries. This combination of visual elements allows the various stakeholders in the medical field to identify critical injury patterns by sport and prioritise prevention and clinical intervention.

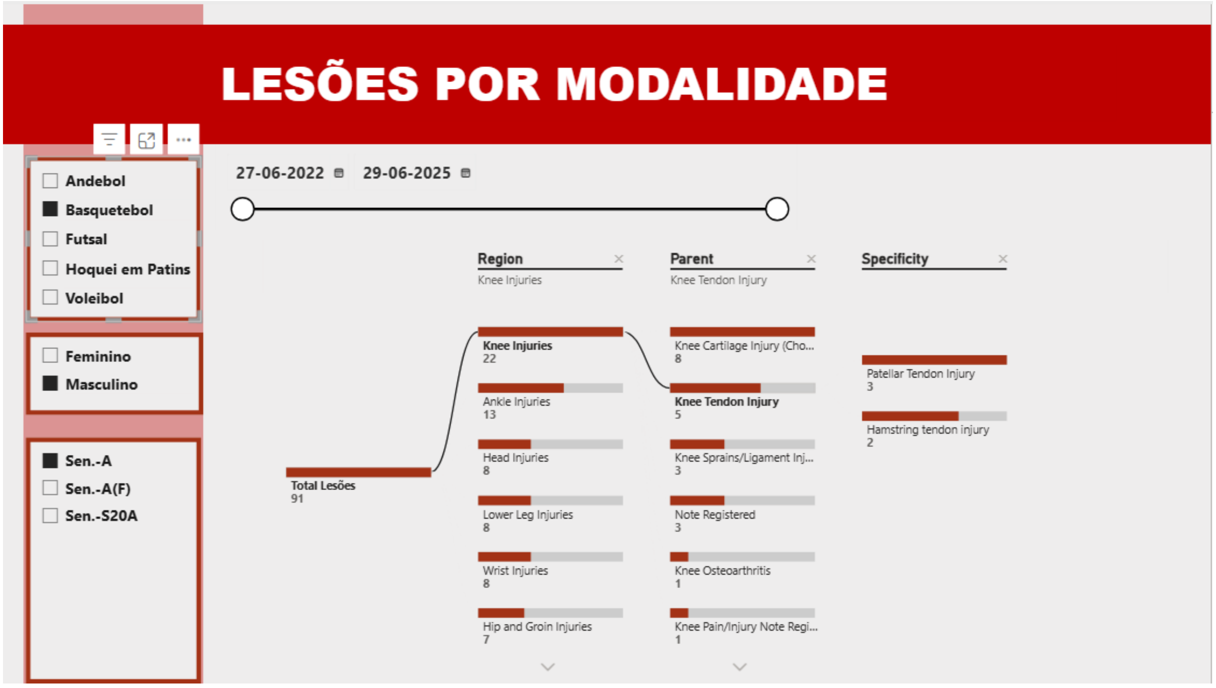

Figure 11 – Page 2 (Injuries by Sport)

The second page of the dashboard, Figure 11, complements the analysis started on the previous page. It highlights the identification of the main injuries by sport, this time with a greater level of clinical detail. The main visual is a decomposition tree graphic, so users can explore injuries hierarchically, from the anatomical region affected to clinical specificity.

In this example, knee injuries (Knee Injuries) are the most common (22 occurrences), being broken down into categories such as ‘Knee Tendon Injury’ or ‘Knee Cartilage Injury (Chondral)’, and further specified into injuries such as ‘Patellar Tendon Injury’ and ‘Hamstring Tendon Injury’. This analysis structure is fundamental for clinical professionals and technical teams, as it provides objective evidence for preventive actions, guided by real data from sports practice, as well as improving descriptive analyses by highlighting clinical events that have occurred in the past.

In addition, the side filters make it possible to segment the data by sport, gender and competitive level, allowing cross-analyses, such as identifying whether ‘Patellar Tendon’ injuries are more frequent in male athletes in senior Basquetebol A. This page thus reinforces the clinical value and operability of the model, by translating injury data into practical information for medical and technical decision-making.

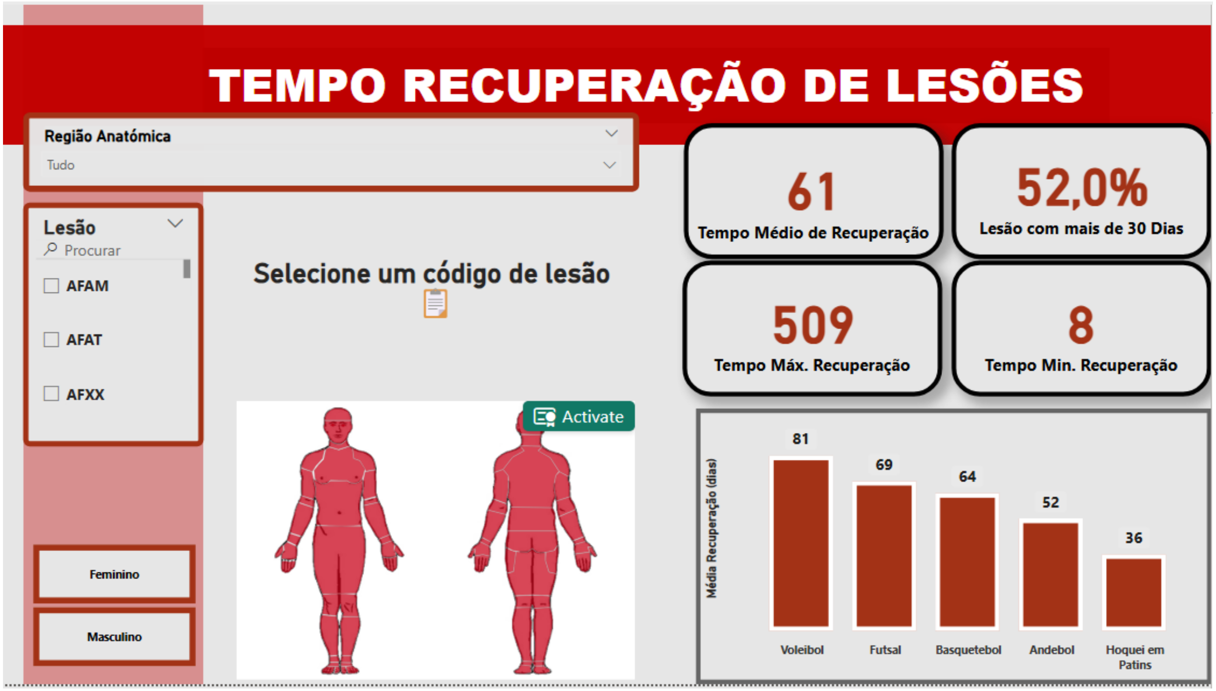

Figure 12 – Page 3 (Injuries Recovery Time)

The Figure 12 shows the third page of the dashboard, designed to help answer the business need 'calculate average recovery times per injury'. In the top right-hand corner, there are informative 'card' type visuals, capable of indicating average recovery times per identified injury and per sport, as well as minimum and maximum recovery times. Also, in the same 'card' format, it is possible to identify the percentage of injuries lasting more than 30 days by anatomical area, represented in the visual of the human body, or by sport. As the main tool, there is the central visual with the description 'Select an injury code', whose purpose is to describe the injury of the Osics code selected in the filter on the left-hand side of the page. In the bottom right-hand corner, a bar graph shows the average injury recovery time (in days) for the five sports.

When you select an area in the 'Região Anatómica' filter, all the Osics codes in the database for that area will appear in the 'Lesão' side filter. For example, selecting the anatomical region 'Ankle Injuries' and then the code "AFXX" will automatically display the information describing the injury in the central box, 'Ankle Fracture', as well as all the calculations corresponding to this injury.

This page helps medical and technical teams to understand the time profile of certain injuries. In this way, when an athlete is diagnosed with a previously recorded injury, teams can anticipate a pattern or trend in the expected recovery time and improve the decision-making process, both in the clinical context and in the competitive framework.

Figure 13 – Page 4 (Medical Clinic Appointments)

This dashboard responds directly to the business need 'analysing the average number of medical consultations per injury' by providing an interactive view of the clinical effort associated with the recovery process for different types of injury. In the bottom left-hand corner, a table shows the average number of medical consultations per anatomical region of the injury, making it possible to identify which types of injury require the most clinical follow-up. The information can be explored in detail using dynamic filters such as sport, gender, age group and time, automatically adjusting the data displayed.

The right-hand panel summarises the main indicators through cards with aggregate values such as total consultations, average number of consultations per injury and total injuries, which allows for an overall analysis of the volume and intensity of clinical follow-up. A bar graph at the bottom right shows the total number of consultations per sport, which shows, for example, that handball and futsal account for a large proportion of the total clinical load. In addition, the centre panel highlights the selection of a specific OSICS code and its detailed analysis of specific injuries. This dashboard is an essential tool for optimising the management of clinical resources, improving the planning and responsiveness of the medical team.

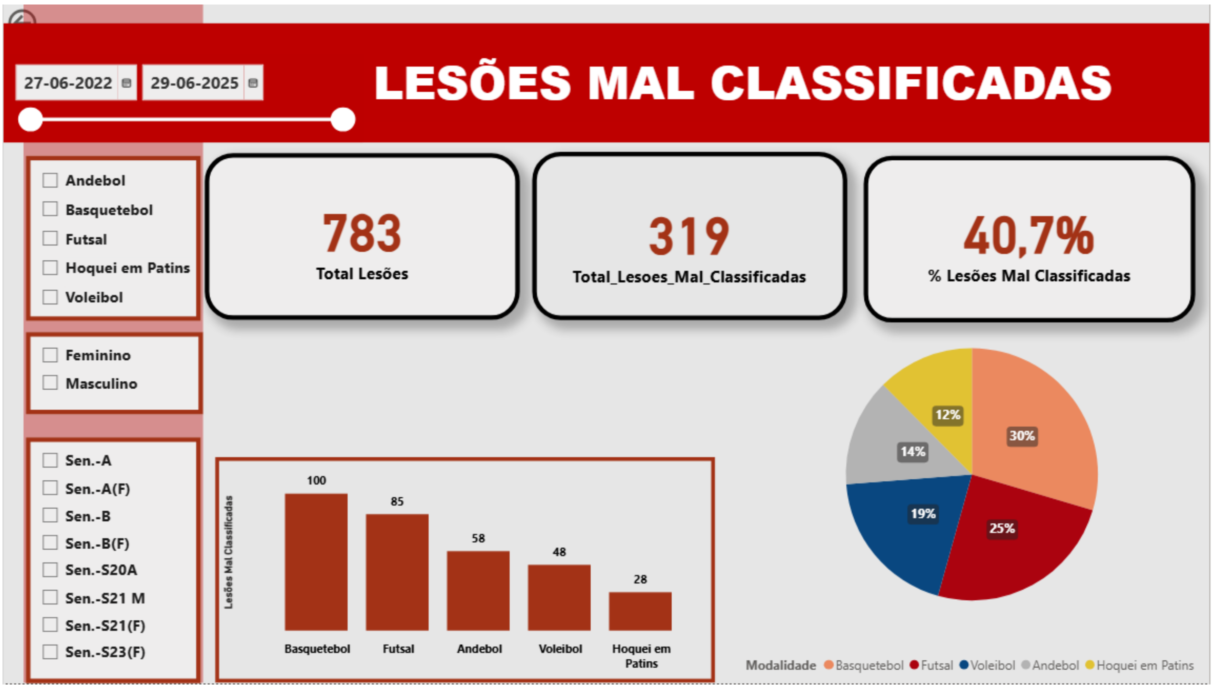

Figure 14 – Page 5 (Misclassified Injuries)

The dashboard presented, in the Figure 14, corresponds to the latest analysis of the Report Sports_Medical_Clinic and contributes to the solution of the business need 'identification of injuries with potential classification problems'. This page makes it possible to quantify and analyse the proportion of injuries that have not been correctly classified in the system, namely those with codes such as 'Not Registered' or other inconsistencies within the scope of OSICS information. This analysis contributes to improving the quality dynamics of clinical records, ensuring greater data reliability for medical and operational decisions.

The top panel provides key indicators such as the total number of injuries, the total number of misclassified injuries and the percentage they represent of the total (40.7%). These figures are highly interactive and dynamic considering the side slicers (sport, gender, age group, time period), which makes it possible to identify contexts with a greater tendency for misclassification. The bar graph highlights the absolute number of injuries misclassified by sport, with basketball and futsal standing out, while the circular graph shows the same information in percentage terms, making it easier to visually compare sports. This dashboard is a useful tool for identifying flaws in the clinical record process and aims to guide, sensitise and stimulate corrective action, which promotes continuous improvement in the quality of clinical information.

5. RESULTS AND DISCUSSION

5.1. ARTEFACT EVALUATION

The aim of evaluating the model developed as part of this research is to understand the end users' perception of its usability, usefulness and practical impact on the management of clinical information at a high-performance sports club. The artefact was designed using the Design Science Research methodology and created using the Microsoft Fabric platform with interactive reports in Power BI, the aim of which is to respond to specific needs previously identified by the clinic's medical, sports and management teams.

This evaluation process is therefore essential to validate the alignment between the identified requirements and the implemented solution, gauging its suitability for the organisation's day-to-day practices. Through the feedback gathered, the aim is not only to validate the effectiveness of the model developed, but also to identify opportunities for improvement, necessary adjustments, new suggested and desired functionalities, and any limitations highlighted in its use. The direct involvement of the stakeholders at this point in the study guarantees a relevant and realistic contribution to the consolidation of the results and the reasoned discussion of the conclusions.

5.2. EVALUATION METHODOLOGY

The model's evaluation phase was designed according to the principles of Design Science Research, which recommends practical and rigorous validation of the solution developed in its real application environment. Considering the applied and organisational nature of the research, the evaluation was carried out through face-to-face interviews, based on a structured script that acted as the main instrument for data collection and feedback.

The questionnaire described above was designed with the aim of obtaining the perception of the artifact's end users, namely doctors, physiotherapists, physiologists and clinical managers, regarding various dimensions of the solution. These dimensions include the usefulness of the system in supporting decision-making, the clarity and accessibility of the dashboards, the reliability of the data presented, and the potential for improving clinical and management processes. The interviews made it possible to collect direct answers to the questionnaire items and to promote open reflection on the practical use of the tool in the day-to-day lives of professionals.

The choice of face-to-face interviews aimed to maximise the richness of the information collected, allowing the researcher to present the artefact and thus clarify doubts, observe spontaneous reactions and explore additional comments that would be difficult to record using a stand-alone form. This method favours proximity to the real context in which the model is used, contributing to a more robust and contextualised analysis of the evaluation results.

5.3. QUESTIONS GUIDE

The script of questions was developed with the intention of guiding the interview with the medical clinic's stakeholders. The questions were developed with the aim of evaluating different aspects of the artefact, including its usefulness, usability, data quality and practical impact on the management and recovery of athletes.

1. **What do you think of the general organisation of the dashboard? Is it easy to interpret?** Evaluate the usability of the dashboard and check whether users find the structure and layout of the information intuitive and easy to explore.

2. **Do you think the number of filters and customisation options is adequate for your needs?** Check that the customisation and filtering options available in the template are sufficient to meet a variety of needs, allowing users to shape the visualisations according to the context.

3. **Do you feel that the data presented meets the needs of your area?** Investigate whether the specific needs of each stakeholder (doctors, physiotherapists, physiologists, etc.) are being met by the artefact, ensuring that the visualisations provide relevant information.

4. **Were you able to identify any errors or inconsistencies in the data submitted?** Evaluate the quality and reliability of the data presented by the system by checking for discrepancies or errors in the data presented. This point is crucial if the user's confidence in the artefact is to be compromised.

5. **Does the artefact contribute to the efficiency of the clinic's daily work? In what way?** To gain an insight into the practical impact of the artefact on the day-to-day running of the clinic, checking whether it facilitates routines and improves the productivity of healthcare professionals.

6. **How do you rate the integration of data from different areas (medicine, physiotherapy, physiology and coaching)?** Check that the integration of data between different functional areas (medicine, physiotherapy, etc.) is successfully applied, allowing a unified view of the athletes' recovery process.

7. **What do you think about visualising historical data? Can it contribute to the planning and management of the clinic?** Evaluate the historical usefulness of the visualisations and see if users think that access to data from past eras contributes to better planning and management of the clinic.

8. **<u>Do visualisations facilitate decision-making? Why?</u>** To understand whether interactive visualisations support clinical and management decision-making by analysing information.

9. **<u>What additional functionalities would you like to see in the system?</u>** Identify possible functional gaps and get suggestions on future improvements, ensuring that the model can be refined over time according to the emerging needs of end users.

10. **In general, how satisfied are you with the model and what do you think could be improved?** Obtain an overview of user satisfaction and identify areas for continuous improvement to ensure that the artefact fully meets stakeholder expectations.

This guide has been drawn up to ensure that all the crucial dimensions of the artefact, from its usability to the effectiveness of the data presented, are assessed objectively. The answers provided by the stakeholders will provide a solid basis for validating the solution developed and identifying potential areas for improvement, bringing the artefact increasingly into line with the real needs of the sports medicine clinic.

5.4. Results Discussion

It was possible to present the artefact developed and record the opinions of 8 of the organisation's end users who are familiar with the origin of the data, its relevance and its impact on the organisation. The stakeholders involved cover the various medical, technical and management areas of the clinic, as shown in the Table 6.

Table 6 - Identification of the Stakeholders Interviewed

End User Interviewed	Function Sector
Head of Physiotherapy	Medical Clinic
Senior Team Physiologist	Technical Staff
Sports Physiatrist Doctor	Medical Staff
Senior Team Head Coach	Technical Staff
Senior Team Physiologist	Technical Staff
Senior Team Physiotherapist	Medical Staff
Assistant Coach Senior Team	Technical Staff
Medical Clinic Operations Manager	Medical Clinic

In the general context, it was possible to carry out personal interviews with all the stakeholders mentioned in the Table 6. The duration of each session was approximately 20 minutes, with 10 minutes devoted to the presentation and demonstration of the model, and the remaining minutes to filling in the questionnaire developed. The results obtained from a total of 8 questionnaires are analysed below.

1. **What do you think of the general organisation of dashboards? Are they easy to interpret?** 75% answered 'Excellent organisation, very easy to interpret' and 25% answered 'Well organised and generally easy to interpret'. There was general and extremely positive satisfaction with the usability, organisation, structure and interpretation of the dashboards.

2. **Do you consider the number of filters and customisation options to be adequate for your needs?** 87.5% of the stakeholders interviewed consider the diversity of existing filters and their needs to be 'Very Adequate'. Only 1 response considered it 'Adequate'. Filters are an integral and crucial part of the model's dynamism, personalisation and interactivity.

3. **Do you think the data presented meets the needs of your area?** 87.5 per cent of those involved considered the connection between the data presented and the needs of the specific area corresponding to each end user to be 'Very Adequate' and 12.5 per cent considered it to be 'Adequate'. The Senior Team Physiotherapist emphasised the need to compare the athlete's physical condition with the state of activity in each injury, i.e. whether the athlete is playing or inactive. The same professional mentioned that it would also be relevant to obtain information on the context of the injury (injury sustained during a game or training session) and whether it was caused by trauma or overload. The Assistant Coach Senior Team notes that this is a tool that reinforces the veracity of the recovery time as part of the decision-making process involving the medical and technical teams and the injured athlete.

4. **Were you able to identify any errors or inconsistencies in the data presented?** No errors or inconsistencies in the data were detected during the presentation and demonstration of the model. 7 end users registered the answer 'Never' and only 1 registered 'Rarely'. In general, the model has data, concepts and denominations that are perfectly identified and familiar with the sphere surrounding the medical clinic of the sports club analysed, since several end users from different specific areas did not register any inconsistencies in the data observed.

5. **<u>Does the artefact contribute to the efficiency of the clinic's daily work? In what way?</u>** All the interviewees answered 'It contributes significantly'. The various end users consider the artefact to be extremely useful in the daily routine of the sports medicine clinic. The Head of Physiotherapy at the sports medicine clinic recognises the extreme importance of the data in terms of the descriptive analysis of past events and the need to change practices for future behaviour. She defends it and says: 'data must support practice'. The Sports Doctor interviewed recognises that the artefact contributes to improving and monitoring clinical processes and that it is possible to verify, identify and correct errors in the injury process of a particular athlete. The Medical Clinic Operations Manager states that the artefact makes it possible to improve the interpretation of the management of consultation times by sport, since each sport is associated with a doctor in charge. Finally, the Assistant Coach Senior Team recognises that the artefact contributes to increased clarity and transparency in decision-making processes because the information presented is real, truthful and factual.

6. **<u>How do you rate the integration of data from the different areas (medical, physiotherapy, physiology and technical)?</u>** 75% of respondents rated the successful integration of data from different areas and standardised on a single platform as 'Very Satisfactory'. 1 respondent classified the integration as 'Satisfactory', recognising that the artefact has the potential to be classified as 'Very Satisfactory' in the future. One Senior Team Physiotherapist, on the other hand, rated it as 'Neutral', justifying that the integration of the data could be considered inconclusive, as the success of the data in terms of the athletes' recovery process depends on various factors such as the specific nature of the injury, the function and profile of the athlete, as well as the sport they practise.

7. **<u>What do you think about visualising historical data? Can it contribute to the planning and management of the clinic?</u>** Strong and general agreement was recorded regarding the contribution of the analysed information to the planning and management of the clinic. 6 end users registered 'Totally Agree' and 2 registered 'Partially Agree'.

8. **<u>Do the visualisations facilitate decision-making? Why?</u>** 5 end users registered 'Totally Agree' and 3 registered 'Partially Agree'. Both Senior Team Physiologists interviewed consider that the model aids the decision-making process since it is

possible to analyse and understand the athletes' recovery time and process, however they warn that although the model is a useful tool, it is not the decisive tool for the outcome of the decision-making process. The Sports Physiatrist Doctor states that the artefact facilitates decision-making in terms of understanding time expectations for recovery from a particular injury.

9. **What additional functionalities would you like to see in the system?** 87.5% of stakeholders expressed various functionalities that could add analytical value to the artefact in the future.

   - Differentiate the intensity of the colour of the different anatomical regions by volume of injuries in the graphic visual of the human body.
   - Insert a filter for sports seasons (e.g. '2022/2023').
   - Insert a visual graph involving the variables of time, injuries and sports.
   - Identify the context of each recorded injury.
   - Identify the mechanism of each recorded injury.
   - Consult the athlete's injury recovery process.
   - The development of a parallel platform with information on the current clinical state of the injured athlete.

10. **In general, how satisfied are you with the model and what do you think could be improved?** 100% of the stakeholders interviewed answered 'Very Satisfactory'. A maximum rating was recorded for satisfaction with the artefact developed. Through the various suggestions and observations, it was possible to see that this is a useful and appropriate tool, extremely important for monitoring the different phases of the injury recovery process. The comparison between previous data and factual data is remarkable. Several interviewees recognised that the model has significant potential for improvement and development, the impact of which could be decisive in the various decision-making processes of the different areas involved.

5.5. Users Contributions and Suggestions

Evaluating the artefact with end users made it possible to gather contributions and suggestions aimed at improving the model and expanding its functionalities. In general, there was an extremely positive response to the dashboards, with 100% of stakeholders considering the artefact 'Very Satisfactory' in terms of usefulness, organisation and clarity of data. The interviewees recognised the importance of the artefact for clinical management, particularly in the follow-up of injuries and monitoring the recovery process of athletes and mentioned that the tool contributes to greater transparency and clarity in clinical and technical decisions.

Among the suggestions made by users were improvements and alternatives in the graphical visualisation and interactivity of the model. Highlighting anatomical areas by number of injuries, the introduction of new personalisation filters, the implementation of graphs that relate variables such as time, injuries and sports disciplines, the identification of the context and mechanism of each injury recorded, as well as the panel for consulting clinical processes in real time are the various examples suggested that are aimed at the development and overall improvement of the artefact in order to strengthen its impact on the different medical, technical and clinical management areas.

Overall, the collection of suggestions reflects a genuine interest in expanding the artefact's functionalities, promotes a more in-depth and integrated analysis of the data and contributes to the continuous improvement and streamlining of the sports club's clinical management processes. Implementing these improvements has the potential to significantly increase the model's impact, providing a more detailed and interactive analysis that optimises decision-making and the operational efficiency of the sport’s medical clinic.

6. CONCLUSIONS AND FUTURE WORKS

Throughout this research project, an artefact based on Business Intelligence was developed with the aim of improving the management and efficiency of the medical clinic of a large sports club. Through the implementation of a relational data model and interactive dashboards, it was possible to analyse and optimise processes, promote greater transparency and interpretability in the analysis of injuries and medical consultations, and provide effective support for the decision-making process of the different stakeholders in various areas of the sports organisation.

The DSR methodology guided all stages of the artefact's development, from analysing business needs to implementation and practical evaluation with end users. Based on personal interviews and questionnaires, it was possible to gauge the positive impact of the model in the clinical context, as well as identify areas for improvement that could reinforce future technological developments.

6.1. Goals and Contributions

The main aim of this project was to develop a management and decision support system for the sports club's medical clinic, using Business Intelligence (BI) techniques applied to the athletes' real clinical data. To this end, an artefact was developed using the Microsoft Fabric platform, integrating ETL processes, a relational model in Star Schema, and interactive dashboards in Power BI. The specific objectives defined at the start of the project were fully achieved:

- The creation of a relational data structure optimised for clinical analysis, allowing detailed recording and monitoring of injuries and medical appointments.

- The development of dynamic and customisable dashboards, which allow the different stakeholders to analyse key indicators such as the ‘Top 10 Injuries by Sport’, the ‘Average Recovery Times’, the ‘Average Number of Consultations per Injury’ and even identify potential injury classification problems.

- The integration of data from different areas (medical, physiotherapy, physiology and technical) into a single semantic model, promoting an integrated, cross-cutting view of athletes' clinical records.

The artifact's contributions were recognized by end users, who highlighted the clarity of data presentation, the ease of interpreting the reports, and the valuable support they provide for decision making. Overall, the implemented model proved to be a relevant instrument for clinical management, not only in monitoring injuries and recovery times, but also in optimizing the resources available in the medical clinic.

6.2. STUDY LIMITATIONS

Despite the positive results obtained with the development and implementation of the artifact, there are some limitations to be considered. First, the quality of the data stored on the sports club's internal platform presents occasional inconsistencies, which can influence the analysis performed, such as incomplete injury records that contribute to a poor interpretation of the Osics codes. Although a data cleaning and transformation process was applied during the ETL phase, possible errors in the initial recording of injuries and medical consultations could compromise the integrity of the information presented. The real and internal panorama of the organization aims to raise awareness, be rigorous and comply with the routines for the complete and reliable recording of the various events carried out within the scope of the club's medical clinic.

Additionally, the analysis developed was based on historical data from the last three sports seasons. Although this sample is relevant for identifying injury trends and clinical patterns, the absence of older data may condition and limit the ability to identify long-term evolutions, especially in sports that present seasonal changes in injury types. Furthermore, the lack of real-time integration of medical data recorded in the clinic's internal system may affect the immediate updating of dashboards, resulting in a slight time lag in the analyses performed.

Another aspect to be considered is the dependence on the perception of end users during the interviews carried out. The suggestions and assessments provided, while extremely valuable, are subjective and may reflect only a partial perspective on the model's impact. The implementation of additional quantitative methods for performance assessment, such as efficiency metrics and clinical evolution or reduction of injury recovery times, could complement the analysis performed, making the results even more reliable.

For reasons of simplicity and time limitations in the development and implementation of this model, 2 dimensions tables and 1 fact table were not activated, whose information concerns the clinical scope of physiotherapy and physiology. This aspect reinforces the existence of data in the model that can be explored and analysed in the future, and thus successfully meet the expectations indicated and suggested by several end users interviewed, making it possible to interpret and analyse the clinical processes of recovery and rehabilitation of athletes' injuries.

Finally, the implementation of the artifact focused essentially on the analysis of lesions recorded by anatomical areas and their specificities. However, other aspects related to the athlete, such as physical and psychological profile, medical history, training load, competitive results obtained, among others, were not integrated into the model, representing a future opportunity for the expansion of the system and for an even more complete and comprehensive analysis.

6.3. FUTURE RESEARCH

The development of the artifact allowed achieving significant results in supporting the clinical management of the sports club, contributing to the dynamization, monitoring and analysis of injury recovery processes. However, there are several opportunities for improving and expanding the solution, which could be explored in future work to increase the impact and efficiency of the model.

One of the main suggestions for evolution focuses on real-time data integration. Currently, the model operates from a descriptive analysis perspective, that is, based on periodic loading of historical data, which, although effective for retrospective analysis, limits the decision-making capacity in real time. The implementation of a data streaming solution, which allows the immediate recording of consultations, physiotherapy sessions and clinical conditions of athletes, would enable continuous monitoring, easier accessibility and faster response capacity from the various medical and sports technical teams.

Another aspect that deserves future attention is the integration of other dimensions of the athlete's health, such as physical and psychological aspects, training load, fatigue levels, sleep monitoring and nutritional condition. Correlation between these variables and recorded injuries could provide additional useful information related to risk factors and preventive strategies.

A promising path for the development of this artifact will be predictive analysis. Using machine learning to identify injury patterns and trends based on athletes' clinical histories, modalities, ages, profiles and training load could allow the anticipation of potential injuries and the definition of personalized preventive strategies. This approach would significantly contribute to reducing periods of physical inactivity and more efficient management of clinical resources.

Finally, the creation of a parallel and interactive interface dedicated to athletes and technical staff, enabling cross-sectional access to specific and personalized reports on the recovery status, evolution statistics and medical recommendations. This dynamic would increase transparency, trust and collaboration between the different stakeholders. This platform could include real-time notifications about changes in the recovery process, which would facilitate agile and effective communication and interactivity dynamics between athletes and the various members of the technical and medical teams.

6.4. Final Considerations

In the context of a high-level sports club, the creation and development of the model represents a significant contribution to clinical management and monitoring of injury recovery processes. Starting from a gap identified as indicated in the Introduction and Literature Review, in which there was a shortage of BI technological solutions specifically aimed at the integrated management of clinical data in sports environments, this research sought to fill this gap by creating a relational analytical model of data and aimed at decision making.

By implementing a well-structured architecture, based on consolidated data engineering and interactive visualization practices, it was possible to create a system that not only monitors the process of identifying injuries and recovering athletes, but also optimizes the management of clinical resources and facilitates strategic and preventive planning for medical and technical teams. The validation carried out with end users highlighted the relevance and usefulness of the model, the clarity of the visualizations, the ease of interpreting the data and the ability to respond to the needs of daily and operational routines of the medical clinic.

It is expected that this research will serve as a reference for future technological developments in the sports sector, contributing to a deeper knowledge about the applicability of BI in high-performance sports clinical environments. Furthermore, it is hoped that this work can enrich academic literature in the sports and health sector, demonstrating that the integration of data analysis technologies can transform the way injury recovery processes are interpreted, optimizing decisions and increasing effectiveness in the management of high-level athletes.

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APPENDIX A – EXISTING TABLES IN THE FIRST ETL PHASE

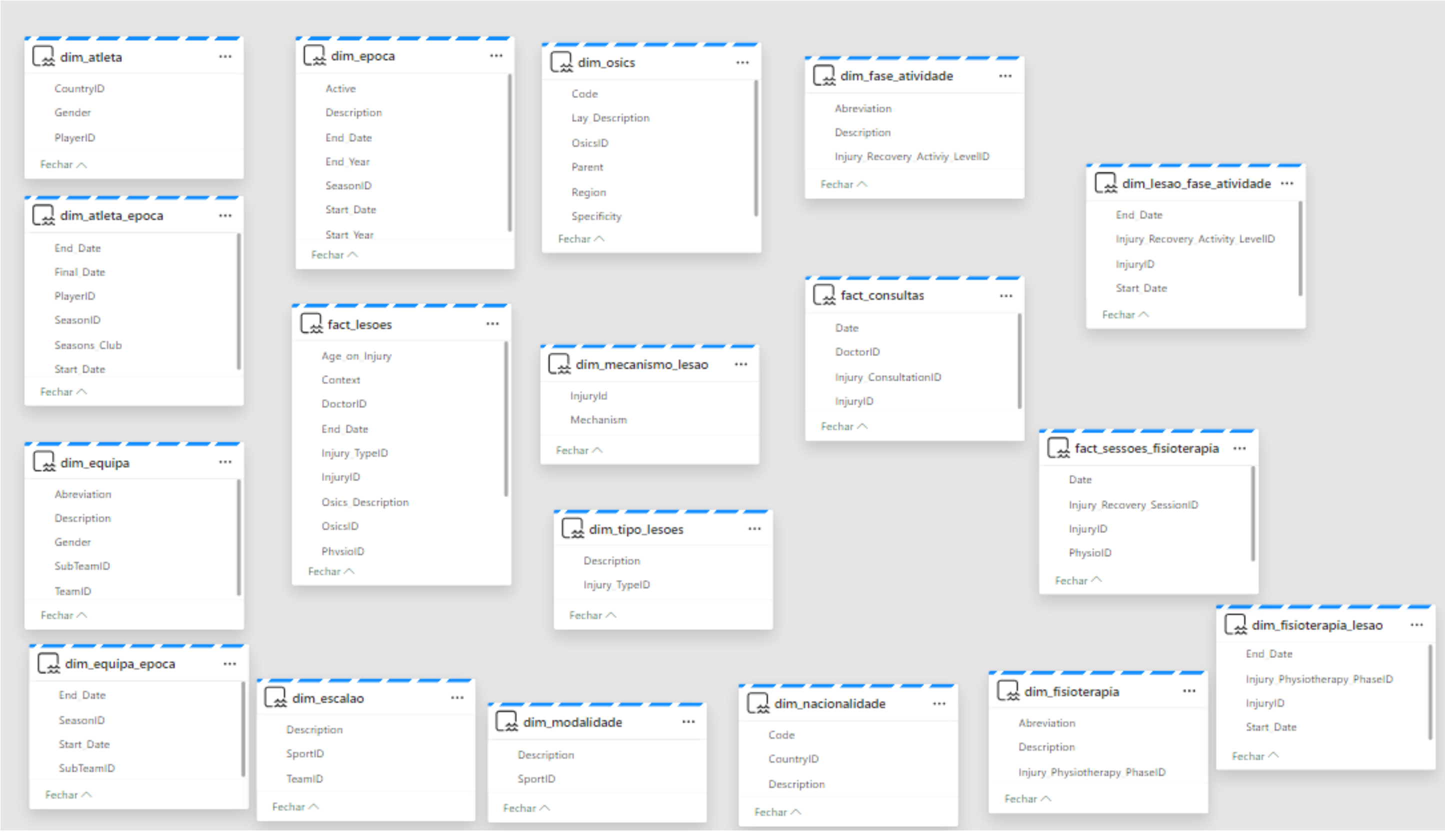

Figure 15 - - All tables loaded at the beginning in the Staging Area

APPENDIX B – SEMANTIC MODEL PREPARED FOR REPORT ANALYSIS

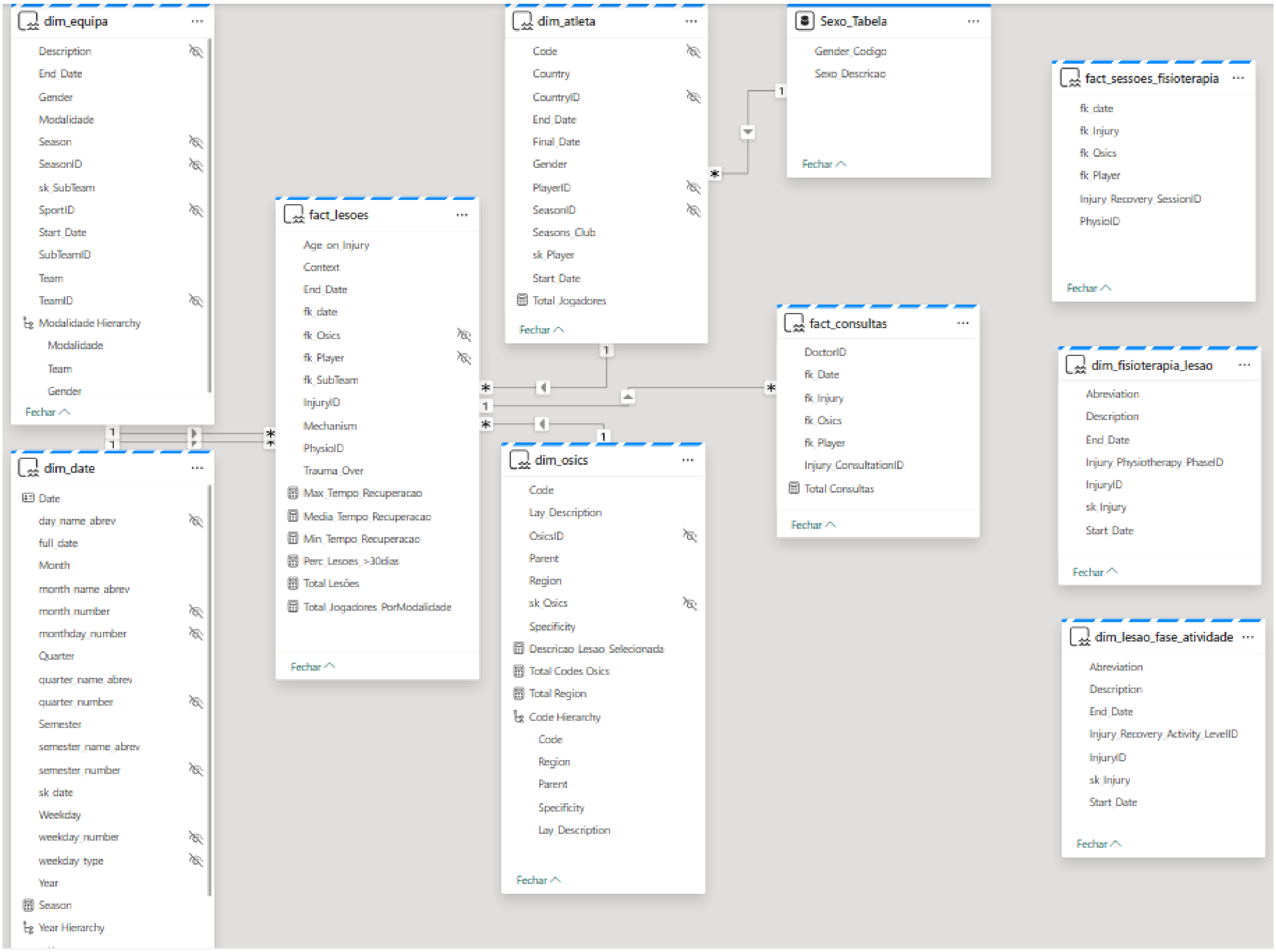

Figure 16 - Final Data Semantic Model

APPENDIX C – HEAD OF PHYSIOTHERAPY INTERVIEW

Tese: Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Função: Head Of Physiotherapy

Área de atuação (clínica/gestão/outro): Staff Clínico

Data: _16 / 05 / 2025

Instruções: Por favor, responda às questões abaixo com base na sua experiência ao interagir com o dashboard. As suas respostas são fundamentais para avaliar a utilidade prática do artefato desenvolvido.

A. COMPREENSÃO E USABILIDADE

1. O que pensa da organização geral do dashboard? É fácil de interpretar?

Muito difícil de interpretar e mal organizado [ ]
Difícil de interpretar, com uma estrutura pouco clara [ ]
Razoavelmente organizado, mas com espaço para melhorias [ ]
Bem organizado e geralmente fácil de interpretar [ ]
Excelente organização, muito fácil de interpretar e navegar [X]

2. Considera que o número de filtros e opções de personalização é adequado às suas necessidades?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

B. RELEVÂNCIA E UTILIDADE

3. Considera que os dados apresentados respondem às necessidades da sua área?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

4. Conseguiu identificar algum erro ou inconsistência nos dados apresentados?

Nunca [X]
Raramente [ ]
Ocasionalmente [ ]
Frequentemente [ ]
Muitos erros [ ]

5. O artefato contribui para a eficiência no trabalho diário da clínica? De que forma?

Não contribui em nada [ ]

Contribui muito pouco [ ]
Contribui razoavelmente [ ]
Contribui significativamente [X]

<u>Comentário: Os dados são um suporte muito importante na análise descritiva do que foi realizado, como rampa para eventual necessidade de mudança de práticas ou comportamentos do futuro.</u>

6. Como avalia a integração dos dados provenientes das diferentes áreas (médica, fisioterapia, fisiologia e técnica) relativamente à recuperação dos atletas?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

<u>C. APROFUNDAMENTO E TOMADA DE DECISÃO</u>
7. Qual é a sua opinião sobre a visualização dos dados históricos? Pode contribuir para o planeamento e gestão da clínica?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

<u>Comentário: Os dados devem suportar a prática.</u>

8. As visualizações facilitam a tomada de decisão? Porquê?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

<u>D. SATISFAÇÃO GLOBAL E MELHORIA</u> 9. Que funcionalidades adicionais gostaria de ver no sistema?
Diferenciar a intensidade da cor na área anatómica selecionada por volume de lesões. (no corpo humano visual)

10. De maneira geral, qual a sua satisfação com o modelo?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

APPENDIX D – SENIOR TEAM PHYSIOLOGIST INTERVIEW

Tese: Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Função: Fisiologista Equipa Sénior

Área de atuação (clínica/gestão/outro): Staff Clínico

Data: 14 / 05/ 2025

Instruções: Por favor, responda às questões abaixo com base na sua experiência ao interagir com o dashboard. As suas respostas são fundamentais para avaliar a utilidade prática do artefato desenvolvido.

A. COMPREENSÃO E USABILIDADE

1. O que pensa da organização geral do dashboard? É fácil de interpretar?

Muito difícil de interpretar e mal organizado	[ ]
Difícil de interpretar, com uma estrutura pouco clara	[ ]
Razoavelmente organizado, mas com espaço para melhorias	[ ]
Bem organizado e geralmente fácil de interpretar	[ ]
Excelente organização, muito fácil de interpretar e navegar	[X]

2. Considera que o número de filtros e opções de personalização é adequado às suas necessidades?

Nada adequado	[ ]
Pouco adequado	[ ]
Razoavelmente adequado	[ ]
Adequado	[X]
Muito adequado	[ ]

B. RELEVÂNCIA E UTILIDADE

3. Considera que os dados apresentados respondem às necessidades da sua área?

Nada adequado	[ ]
Pouco adequado	[ ]
Razoavelmente adequado	[ ]
Adequado	[ ]
Muito adequado	[X]

4. Conseguiu identificar algum erro ou inconsistência nos dados apresentados?

Nunca	[X]
Raramente	[ ]
Ocasionalmente	[ ]
Frequentemente	[ ]
Muitos erros	[ ]

5. O artefato contribui para a eficiência no trabalho diário da clínica? De que forma?

Não contribui em nada	[ ]

Contribui muito pouco [ ]
Contribui razoavelmente [X]
Contribui significativamente [ ]

6. Como avalia a integração dos dados provenientes das diferentes áreas (médica, fisioterapia, fisiologia e técnica) relativamente à recuperação dos atletas?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

<u>**C. APROFUNDAMENTO E TOMADA DE DECISÃO**</u>
7. Qual é a sua opinião sobre a visualização dos dados históricos? Pode contribuir para o planeamento e gestão da clínica?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [X]
Concordo totalmente [ ]

8. As visualizações facilitam a tomada de decisão? Porquê?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [X]
Concordo totalmente [ ]
<u>Comentário: O modelo auxilia o processo de tomada de decisão, mas não é a última e única ferramenta para tomar a decisão. É uma das ferramentas que ajuda a tomar a decisão. Tem potencial de ser essa ferramenta.</u>

<u>**D. SATISFAÇÃO GLOBAL E MELHORIA**</u>
9. Que funcionalidades adicionais gostaria de ver no sistema?
Gostaria de ver as lesões por tempo de exposição (tempo de atividade física, por exemplo mais treinos = mais lesões. X lesões/y horas de exposição). Adicionaria a funcionalidade filtro de época. Um visual gráfico com tempo/lesões/modalidade.

10. De maneira geral, qual a sua satisfação com o modelo e o que considera que pode ser melhorado?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]
<u>Comentário: Ferramenta útil com muito pontecial de ser melhorado e desenvolvido.</u>

APPENDIX E – MEDICAL CLINIC DOCTOR PHYSIATRIST

Tese: Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Função: Médico Fisiatra

Área de atuação (clínica/gestão/outro): Staff Clínico

Data: 15/ 05/ 2025

Instruções: Por favor, responda às questões abaixo com base na sua experiência ao interagir com o dashboard. As suas respostas são fundamentais para avaliar a utilidade prática do artefato desenvolvido.

A. COMPREENSÃO E USABILIDADE

1. O que pensa da organização geral do dashboard? É fácil de interpretar?

Muito difícil de interpretar e mal organizado [ ]
Difícil de interpretar, com uma estrutura pouco clara [ ]
Razoavelmente organizado, mas com espaço para melhorias [ ]
Bem organizado e geralmente fácil de interpretar [ ]
Excelente organização, muito fácil de interpretar e navegar [X]

2. Considera que o número de filtros e opções de personalização é adequado às suas necessidades?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

B. RELEVÂNCIA E UTILIDADE

3. Considera que os dados apresentados respondem às necessidades da sua área?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [X]
Muito adequado [ ]
Comentário: Visão geral de monitorização. Não é relevante quanto à área.

4. Conseguiu identificar algum erro ou inconsistência nos dados apresentados?

Nunca [X]
Raramente [ ]
Ocasionalmente [ ]
Frequentemente [ ]
Muitos erros [ ]

5. O artefato contribui para a eficiência no trabalho diário da clínica? De que forma?

Não contribui em nada [ ]
Contribui muito pouco [ ]
Contribui razoavelmente [ ]
Contribui significativamente [X]
Comentário: Melhor gestão e monitorização dos processos clínicos e acompanhamento. É possível verificar e detetar erros no encadeamento do processo de lesão de um atleta e corrigir os mesmos erros.

6. Como avalia a integração dos dados provenientes das diferentes áreas (médica, fisioterapia, fisiologia e técnica) relativamente à recuperação dos atletas?

Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

C. APROFUNDAMENTO E TOMADA DE DECISÃO

7. Qual é a sua opinião sobre a visualização dos dados históricos? Pode contribuir para o planeamento e gestão da clínica?

Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

8. As visualizações facilitam a tomada de decisão? Porquê?

Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [X]
Concordo totalmente [ ]
Comentário: Facilita a tomada de decisão para futuros casos em termos de entendimento de expectativas temporais para a recuperação de determinada lesão.

D. SATISFAÇÃO GLOBAL E MELHORIA

9. Que funcionalidades adicionais gostaria de ver no sistema?

Nada a acrescentar

10. De maneira geral, qual a sua satisfação com o modelo?

Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]
Comentário: É uma ferramenta que poderá influenciar a decisão clínica e reveste-se de enorme relevância para a monitorização das diferentes etapas no
processo de recuperação de lesão. Estabelece uma comparação com dados prévios e factuais.

APPENDIX F – SENIOR TEAM HEAD COACH INTERVIEW

Tese: Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Função: Treinador Principal de uma Modalidade

Área de atuação (clínica/gestão/outro): Staff Técnico

Data: _16 //05 /2025

Instruções: Por favor, responda às questões abaixo com base na sua experiência ao interagir com o dashboard. As suas respostas são fundamentais para avaliar a utilidade prática do artefato desenvolvido.

A. COMPREENSÃO E USABILIDADE

1. O que pensa da organização geral do dashboard? É fácil de interpretar?

Muito difícil de interpretar e mal organizado [ ]
Difícil de interpretar, com uma estrutura pouco clara [ ]
Razoavelmente organizado, mas com espaço para melhorias [ ]
Bem organizado e geralmente fácil de interpretar [ ]
Excelente organização, muito fácil de interpretar e navegar [X]

2. Considera que o número de filtros e opções de personalização é adequado às suas necessidades?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

Comentário: É possível navegar rapidamente aos setores pretendidos, quanto às equipa/modalidades e fator fase da temporada.

B. RELEVÂNCIA E UTILIDADE

3. Considera que os dados apresentados respondem às necessidades da sua área?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

4. Conseguiu identificar algum erro ou inconsistência nos dados apresentados?

Nunca [X]
Raramente [ ]
Ocasionalmente [ ]
Frequentemente [ ]
Muitos erros [ ]

5. O artefato contribui para a eficiência no trabalho diário da clínica? De que forma?

Não contribui em nada [ ]
Contribui muito pouco [ ]
Contribui razoavelmente [ ]
Contribui significativamente [X]

6. Como avalia a integração dos dados provenientes das diferentes áreas (médica, fisioterapia, fisiologia e técnica) relativamente à recuperação dos atletas?

Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

C. APROFUNDAMENTO E TOMADA DE DECISÃO

7. Qual é a sua opinião sobre a visualização dos dados históricos? Pode contribuir para o planeamento e gestão da clínica?

Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

8. As visualizações facilitam a tomada de decisão? Porquê?

Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

D. SATISFAÇÃO GLOBAL E MELHORIA

9. Que funcionalidades adicionais gostaria de ver no sistema?

Identificar o contexto da lesão ou o mecanismo. A origem da lesão.

10. De maneira geral, qual a sua satisfação com o modelo?

Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

APPENDIX G – SENIOR TEAM PHYSIOLOGIST INTERVIEW

Tese: Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Função: Fisiologista Clínica e Staff Tecnico Equipa Sénior

Área de atuação (clínica/gestão/outro): Staff Técnico

Data: 14 / 05 /2025

Instruções: Por favor, responda às questões abaixo com base na sua experiência ao interagir com o dashboard. As suas respostas são fundamentais para avaliar a utilidade prática do artefato desenvolvido.

A. COMPREENSÃO E USABILIDADE

1. O que pensa da organização geral do dashboard? É fácil de interpretar?

Muito difícil de interpretar e mal organizado [ ]
Difícil de interpretar, com uma estrutura pouco clara [ ]
Razoavelmente organizado, mas com espaço para melhorias [ ]
Bem organizado e geralmente fácil de interpretar [X]
Excelente organização, muito fácil de interpretar e navegar [ ]

2. Considera que o número de filtros e opções de personalização é adequado às suas necessidades?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

B. RELEVÂNCIA E UTILIDADE

3. Considera que os dados apresentados respondem às necessidades da sua área?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

4. Conseguiu identificar algum erro ou inconsistência nos dados apresentados?

Nunca [X]
Raramente [ ]
Ocasionalmente [ ]
Frequentemente [ ]
Muitos erros [ ]

5. O artefato contribui para a eficiência no trabalho diário da clínica? De que forma?

Não contribui em nada [ ]
Contribui muito pouco [ ]

Contribui razoavelmente [ ]
Contribui significativamente [X]

6. Como avalia a integração dos dados provenientes das diferentes áreas (médica, fisioterapia, fisiologia e técnica) relativamente à recuperação dos atletas?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [X]
Muito satisfatória [ ]

<u>Comentário: Tem potencial de ser desenvolvido e de ser extramamente satisfatório</u>

<u>C. APROFUNDAMENTO E TOMADA DE DECISÃO</u>
7. Qual é a sua opinião sobre a visualização dos dados históricos? Pode contribuir para o planeamento e gestão da clínica?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

8. As visualizações facilitam a tomada de decisão? Porquê?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

<u>Comentário: Através da informação geral do artefacto consigo perceber tempos de recuperação, feedbacks ao staff técnicos, timings, processos, etc.</u>

<u>D. SATISFAÇÃO GLOBAL E MELHORIA</u>
9. Que funcionalidades adicionais gostaria de ver no sistema?
Ter o processo de recuperação e tipo de trabalho desenvolvido, nas diferentes fases e no contexto temporal.

10. De maneira geral, qual a sua satisfação com o modelo?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

APPENDIX H – SENIOR TEAM PHYSIOTHERAPIST INTERVIEW

Tese: Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Função: Fisioterapeuta de Modalidades Sénior

Área de atuação (clínica/gestão/outro): Staff Clínico

Data: 10/ 05/ 2025

Instruções: Por favor, responda às questões abaixo com base na sua experiência ao interagir com o dashboard. As suas respostas são fundamentais para avaliar a utilidade prática do artefato desenvolvido.

A. COMPREENSÃO E USABILIDADE

1. O que pensa da organização geral do dashboard? É fácil de interpretar?

Muito difícil de interpretar e mal organizado [ ]
Difícil de interpretar, com uma estrutura pouco clara [ ]
Razoavelmente organizado, mas com espaço para melhorias [ ]
Bem organizado e geralmente fácil de interpretar [X]
Excelente organização, muito fácil de interpretar e navegar [ ]

2. Considera que o número de filtros e opções de personalização é adequado às suas necessidades?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

B. RELEVÂNCIA E UTILIDADE

3. Considera que os dados apresentados respondem às necessidades da sua área?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

Comentário: Seria importante comparar as lesões com “Timeloss” ou “Condição clínica” (se o atleta está a jogar ou parado/perda de unidade(s) de treino. Seria interessante colocar se a lesão é traumática ou sobrecarga (TraumaOverUse). Distinção do Contexto (se é treio ou jogo).

4. Conseguiu identificar algum erro ou inconsistência nos dados apresentados?

Nunca [ ]
Raramente [X]
Ocasionalmente [ ]
Frequentemente [ ]
Muitos erros [ ]

5. O artefato contribui para a eficiência no trabalho diário da clínica? De que forma?

Não contribui em nada [ ]
Contribui muito pouco [ ]
Contribui razoavelmente [ ]
Contribui significativamente [X]
Comentário: Consegue-se sintetizar dados quantitativos e estabelecer relações entre diversos fatores. Com isto é possível concluir informações úteis adicionais à atualidade. É possível compreender o panorama geral da clínica.

6. Como avalia a integração dos dados provenientes das diferentes áreas (médica, fisioterapia, fisiologia e técnica) relativamente à recuperação dos atletas?

Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [X]
Satisfatória [ ]
Muito satisfatória [ ]
Comentário: Inconclusiva. Depende de diversos fatores tais como a especificidade da lesão do atleta, e da função e perfil do atleta e modalidade do atleta.

C. APROFUNDAMENTO E TOMADA DE DECISÃO

7. Qual é a sua opinião sobre a visualização dos dados históricos? Pode contribuir para o planeamento e gestão da clínica?

Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [X]
Concordo totalmente [ ]
Comentário: É percetível a afluência de consultas na clínica relativamente a períodos temporais específicos.

8. As visualizações facilitam a tomada de decisão? Porquê?

Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [X]
Concordo totalmente [ ]

D. SATISFAÇÃO GLOBAL E MELHORIA

9. Que funcionalidades adicionais gostaria de ver no sistema?

Seria interessante e prático o staff técnico ter acesso a uma plataforma paralela com informações em tempo real com o estado atual clínico do atleta com notas relevantes.

10. De maneira geral, qual a sua satisfação com o modelo e o que considera que pode ser melhorado?

Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]
Comentário: No Dashboard Tempo Recuperação de lesões devo adicionar mais informação referente ao código OSICS. Muito satisfatório relativamente às questões colocadas.

APPENDIX I – SENIOR TEAM ASSISTANT COACH INTERVIEW

Tese: Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Função: Trinador Adjunto Staff Técnico Equipa Sénior

Área de atuação (clínica/gestão/outro): Staff Técnico

Data: 14/05/2025

Instruções: Por favor, responda às questões abaixo com base na sua experiência ao interagir com o dashboard. As suas respostas são fundamentais para avaliar a utilidade prática do artefato desenvolvido.

A. COMPREENSÃO E USABILIDADE

1. O que pensa da organização geral do dashboard? É fácil de interpretar?

Muito difícil de interpretar e mal organizado [ ]
Difícil de interpretar, com uma estrutura pouco clara [ ]
Razoavelmente organizado, mas com espaço para melhorias [ ]
Bem organizado e geralmente fácil de interpretar [ ]
Excelente organização, muito fácil de interpretar e navegar [X]

Comentário: Se eu tivesse acesso a esta plataforma passaria muito tempo a explorar e conhecer todas as lesões.

2. Considera que o número de filtros e opções de personalização é adequado às suas necessidades?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

B. RELEVÂNCIA E UTILIDADE

3. Considera que os dados apresentados respondem às necessidades da sua área?

Nada adequado [ ]
Pouco adequado [ ]
Razoavelmente adequado [ ]
Adequado [ ]
Muito adequado [X]

Comentário: é uma ferramenta útil para discutir o processo de tomada de decisão com a equipa médica, incluindo o atleta, tranquilizando a veracidade do tempo de recuperação.

4. Conseguiu identificar algum erro ou inconsistência nos dados apresentados?

Nunca [X]
Raramente [ ]
Ocasionalmente [ ]
Frequentemente [ ]
Muitos erros [ ]

5. O artefato contribui para a eficiência no trabalho diário da clínica? De que forma?
Não contribui em nada [ ]
Contribui muito pouco [ ]
Contribui razoavelmente [ ]
Contribui significativamente [X]
<u>Comentário: Pelo processo de tomada de decisão, e pela informação factual ao aos intervenientes, staffs e ATLETA.</u>

6. Como avalia a integração dos dados provenientes das diferentes áreas (médica, fisioterapia, fisiologia e técnica) relativamente à recuperação dos atletas?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

<u>C. APROFUNDAMENTO E TOMADA DE DECISÃO</u>
7. Qual é a sua opinião sobre a visualização dos dados históricos? Pode contribuir para o planeamento e gestão da clínica?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]
<u>Comentário: É possível planificar todo o processo de recuperação, das diferentes vertentes, canlendário competitivo, treinos, descanso, etc.</u>

8. As visualizações facilitam a tomada de decisão? Porquê?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

<u>D. SATISFAÇÃO GLOBAL E MELHORIA</u>
9. Que funcionalidades adicionais gostaria de ver no sistema?
Por cada lesão gostaria de consultar todas as incidências de recuperação.

10. De maneira geral, qual a sua satisfação com o modelo?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

<u>Comentário: Tem muito potencial de ser aplicado, e desenvolvido no âmbito geral da clínica do clube e panorama competitivo.</u>

APPENDIX J – MEDICAL CLINIC OPERATIONS MANAGER INTERVIEW

Tese: Improving the Management and Efficiency of a Sports Club Medical Clinic Through Business Intelligence

Função: Gestora de operações (Clínica)

Área de atuação (clínica/gestão/outro): Gestão Clínica

Data: _16 /05/2025

Instruções: Por favor, responda às questões abaixo com base na sua experiência ao interagir com o dashboard. As suas respostas são fundamentais para avaliar a utilidade prática do artefato desenvolvido.

A. COMPREENSÃO E USABILIDADE

1. O que pensa da organização geral do dashboard? É fácil de interpretar?

Muito difícil de interpretar e mal organizado	[ ]
Difícil de interpretar, com uma estrutura pouco clara	[ ]
Razoavelmente organizado, mas com espaço para melhorias	[ ]
Bem organizado e geralmente fácil de interpretar	[ ]
Excelente organização, muito fácil de interpretar e navegar	[X]

Comentário: Muito intuitivo

2. Considera que o número de filtros e opções de personalização é adequado às suas necessidades?

Nada adequado	[ ]
Pouco adequado	[ ]
Razoavelmente adequado	[ ]
Adequado	[ ]
Muito adequado	[X]

B. RELEVÂNCIA E UTILIDADE

3. Considera que os dados apresentados respondem às necessidades da sua área?

Nada adequado	[ ]
Pouco adequado	[ ]
Razoavelmente adequado	[ ]
Adequado	[ ]
Muito adequado	[X]

Comentário: Prevenção de lesão.

4. Conseguiu identificar algum erro ou inconsistência nos dados apresentados?

Nunca	[ ]
Raramente	[X]
Ocasionalmente	[ ]
Frequentemente	[ ]
Muitos erros	[ ]

5. O artefato contribui para a eficiência no trabalho diário da clínica? De que forma?
Não contribui em nada [ ]
Contribui muito pouco [ ]
Contribui razoavelmente [ ]
Contribui significativamente [X]

<u>Comentário: É possível interpretar melhor a gestão do tempo de consultas por modalidade. Cada modalidade está associada por um médico responsável.</u>

6. Como avalia a integração dos dados provenientes das diferentes áreas (médica, fisioterapia, fisiologia e técnica) relativamente à recuperação dos atletas?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [X]
Muito satisfatória [ ]

<u>C. APROFUNDAMENTO E TOMADA DE DECISÃO</u>
7. Qual é a sua opinião sobre a visualização dos dados históricos? Pode contribuir para o planeamento e gestão da clínica?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

8. As visualizações facilitam a tomada de decisão? Porquê?
Discordo totalmente [ ]
Discordo parcialmente [ ]
Neutro [ ]
Concordo parcialmente [ ]
Concordo totalmente [X]

<u>D. SATISFAÇÃO GLOBAL E MELHORIA</u>
9. Que funcionalidades adicionais gostaria de ver no sistema?
Relação da recuperação da lesão com o tempo.

10. De maneira geral, qual a sua satisfação com o modelo?
Muito insatisfatória [ ]
Insatisfatória [ ]
Neutra [ ]
Satisfatória [ ]
Muito satisfatória [X]

APPENDIX K – DIM ATLETA

Table 7 - dim_atleta attributes

COLUMN	DESCRIPTION	DATA TYPES
SK_DATE	DATE SURROGATE KEY	INT
PROPER_DATE	DATE	DATE
FULL_DATE	COMPLETE DATE WRITTEN IN FULL	VARCHAR (100)
MONTHDAY_NUMBER	MONTHDAY	INT
WEEKDAY_NUMBER	WEEKDAY NUMBER	INT
WEEKDAY_NAME	WEEKDAY NAME	VARCHAR (50)
DAY_NAME_ABREV	DAY NAME ABBREVIATION	VARCHAR (50)
WEEKDAY_TYPE	IDENTITY WHETHER'S IT'S A WEEKDAY OR WEEKAND	VARCHAR (20)
MONTH_NUMBER	MONTH NUMBER	INT
MONTH_NAME	MONTH NAME	VARCHAR (50)
MONTH_NAME_ABREV	MONTH NAME ABBREVIATION	VARCHAR (50)
QUARTER_NUMBER	QUARTER NUMBER	INT
QUARTER_NAME_ABREV	QUARTER NAME ABBREVIATION	VARCHAR (50)
QUARTER_NAME	QUARTER NAME	VARCHAR (50)
SEMESTER_NUMBER	SEMESTER NUMBER	INT
SEMESTER_NAME_ABREV	SEMESTER NAME ABBREVIATION	VARCHAR (20)
SEMESTER_NAME	SEMESTER NAME	VARCHAR (50)
YEAR	YEAR	INT

APPENDIX L – DIM DATE

Table 8 - dim_date attributes

COLUMN	DESCRIPTION	DATA TYPES
SK_DATE	DATE SURROGATE KEY	INT
PROPER_DATE	DATE	DATE
FULL_DATE	COMPLETE DATE WRITTEN IN FULL	VARCHAR (100)
MONTHDAY_NUMBER	MONTHDAY	INT
WEEKDAY_NUMBER	WEEKDAY NUMBER	INT
WEEKDAY_NAME	WEEKDAY NAME	VARCHAR (50)
DAY_NAME_ABREV	DAY NAME ABBREVIATION	VARCHAR (50)
WEEKDAY_TYPE	IDENTITY WHETHER'S IT'S A WEEKDAY OR WEEKAND	VARCHAR (20)
MONTH_NUMBER	MONTH NUMBER	INT
MONTH_NAME	MONTH NAME	VARCHAR (50)
MONTH_NAME_ABREV	MONTH NAME ABBREVIATION	VARCHAR (50)
QUARTER_NUMBER	QUARTER NUMBER	INT
QUARTER_NAME_ABREV	QUARTER NAME ABBREVIATION	VARCHAR (50)
QUARTER_NAME	QUARTER NAME	VARCHAR (50)
SEMESTER_NUMBER	SEMESTER NUMBER	INT
SEMESTER_NAME_ABREV	SEMESTER NAME ABBREVIATION	VARCHAR (20)
SEMESTER_NAME	SEMESTER NAME	VARCHAR (50)
YEAR	YEAR	INT

APPENDIX M – DIM EQUIPA

Table 9 - dim_equipa attributes

COLUMN	DESCRIPTION	DATA TYES
SK_SUBTEAM	SUBTEAM SURROGATE KEY	INT
SUBTEAMID	ID OF TEAM	INT
TEAMID	ID OF TEAM BY CATEGORY AND SPORT	INT
SPORTID	ID OF SPORT	INT
MODALIDADE	SPORT DESCRIPTION	VARCHAR (25)
DESCRIPTION	CATEGORY DESCRIPTION	VARCHAR (25)
ABREVIATION	TEAM ABBREVIATION IDENTIFYING THE GENDER AND SUBCATEGORY OF THE TEAM	VARCHAR (25)
GENDER	TEAM GENDER	VARCHAR (25)
SEASONID	ID OF THE SEASON	INT
SEASON_NAME	SEASON NAME IN FORMAT "YYYY/YYYY"	CHAR (9)
START_DATE	SEASON START DATE	DATE
END_DATE	SEASON END DATE	DATE

APPENDIX N – DIM OSICS

Table 10 - dim_osics attributes

COLUMN	DESCRIPTION	DATA TYPES
SK_OSICS	OSICS SURROGATE KEY	INT
OSICSID	ID OF OSICS	INT
CODE	INJURY CODE	VARCHAR (5)
REGION	ANATOMICAL AREA OF THE INJURY	VARCHAR (500)
PARENT	INJURY DETAIL BY ANATOMICAL AREA	VARCHAR (500)
SPECIFICITY	INJURY NAME	VARCHAR (500)
LAY_DESCRIPTION	INJURY DESCRIPTION	VARCHAR (150)

APPENDIX O – DIM FISIOTERAPIA LESAO

Table 11 - dim_fisioterapia_lesoes attributes

COLUMN	DESCRIPTION	DATA TYPES
SK_INJURY	INJURY SURROGATE KEY	INT
INJURYID	ID OF THE INJURY	INT
INJURY_PHYSIOTHERAPY_PHASEID	ID OF THE INJURY PHYSIOTHERAPY PHASE	INT
DESCRIPTION	PHYSIOTHERAPY RECOVERY PHASE DESCRIPTION	VARCHAR (50)
ABREVIATION	PHYSIOTHERAPY RECOVERY PHASE ABREVIATION	VARCHAR (20)
START_DATE	RECOVERY PHASE START DATE	DATE
END_DATE	RECOVERY PHASE END DATE	DATE

APPENDIX P – DIM LESAO FASE ATIVIDADE

Table 12 - dim_lesao_fase_atividade attributes

COLUMN	DESCRIPTION	DATA TYPES
SK_INJURY	INJURY SURROGATE KEY	INT
INJURYID	ID OF THE INJURY	INT
INJURY_RECOVERY_ACTIVITY_LEVELID	ID OF THE INJUREY RECOVERY ACTIVITY LEVEL	INT
DESCRIPTION	RECOREVY ACTIVITY LEVEL DESCRIPTION	VARCHAR (50)
ABREVIATION	RECOVERY ACTIVITY LEVEL ABREVIATION	VARCHAR (20)
START_DATE	RECOVERY ACTIVITY START DATE	DATE
END_DATE	RECOVERY ACTIVITY END DATE	DATE

APPENDIX Q – FACT LESOES

Table 13 - fact_lesoes attributes

COLUMN	DESCRIPTION	DATA TYPES
INJURYID	ID OF THE INJURY	INT
FK_DATE	DATE FOREIGN KEY, EQUAL TO INJURY START DATE	INT
FK_PLAYER	PLAYER FOREIGN KEY	INT
FK_SUBTEAM	SUBTEAM FOREIGN KEY	INT
FK_OSICS	OSICS FOREIGN KEY	INT
MECHANISM	MECHANISM OF THE INJURY ORIGIN	VARCHAR (50)
END_DATE	INJURY END DATE	DATE
CONTEXT	INJURY SPORT CONTEXT	VARCHAR (20)
TRAUMA_OVER	PRESENCE OF TRAUMA	VARCHAR (20)
PHYSIOID	ID OF THE PHYSIOTHERAPIST	INT
AGE_ON_INJURY	PLAYER AGE ON INJURY	INT

APPENDIX R – FACT CONSULTAS

Table 14 - fact_consultas_attributes

COLUMN	DESCRIPTION	DATA TYPES
INJURY_CONSULTATIONID	ID OF THE INJURY CONSULTATION	INT
FK_DATE	DATE FOREIGN KEY, EQUAL TO INJURY START DATE	INT
FK_INJURY	INJURY FOREIGN KEY	INT
FK_PLAYER	PLAYER FOREIGN KEY	INT
FK_OSICS	OSICS FOREIGN KEY	INT
DOCTORID	ID OF THE DOCTOR	INT

APPENDIX S – FACT SESSOES FISIOTERAPIA

Table 15 - fact_sessoes_fisioterapia_attributes

COLUMN	DESCRIPTION	DATA TYPES
INJURY_RECOVERY_SESSIONID	ID OF THE INJURY RECOVERY SESSION	INT
FK_DATE	DATE FOREIGN KEY	INT
FK_INJURY	INJURY FOREIGN KEY	INT
FK_PLAYER	PLAYER FOREIGN KEY	INT
FK_OSICS	OSICS FOREIGN KEY	INT
PHYSIOID	ID OF THE PHYSIOTHERAPIST	INT